Loeblein's Chemistry PhET clicker questions

Trish Loeblein

phet.colorado.edu

Table of contents by simulation

Gas Properties Review

Describe image of gases using words and diagrams

1. **How gases are distinguishable from a solid or liquid**
2. **How the particle mass and gas temperature affect the image.**
3. **How the size and speed of gas molecules relate to everyday objects**

See also “Physics Topics for Gases handout”

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Gas Properties: Understanding gas model

Goals: Describe a molecular model of **gas pressure**.

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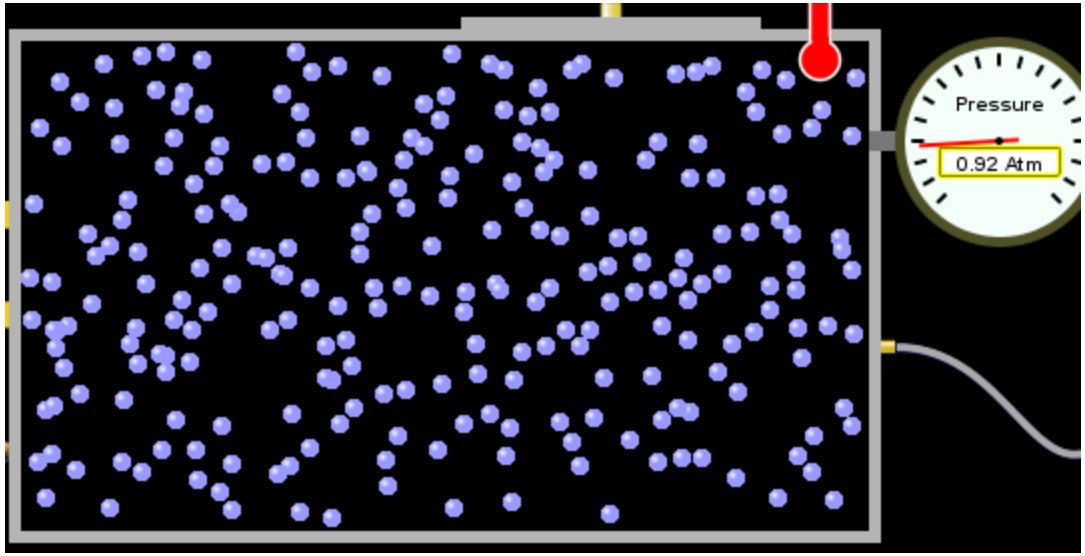
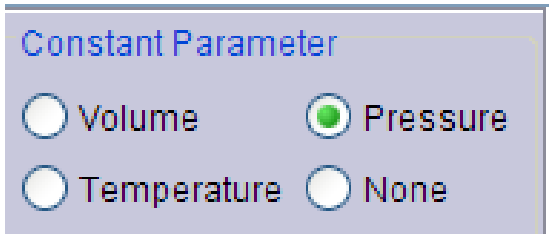
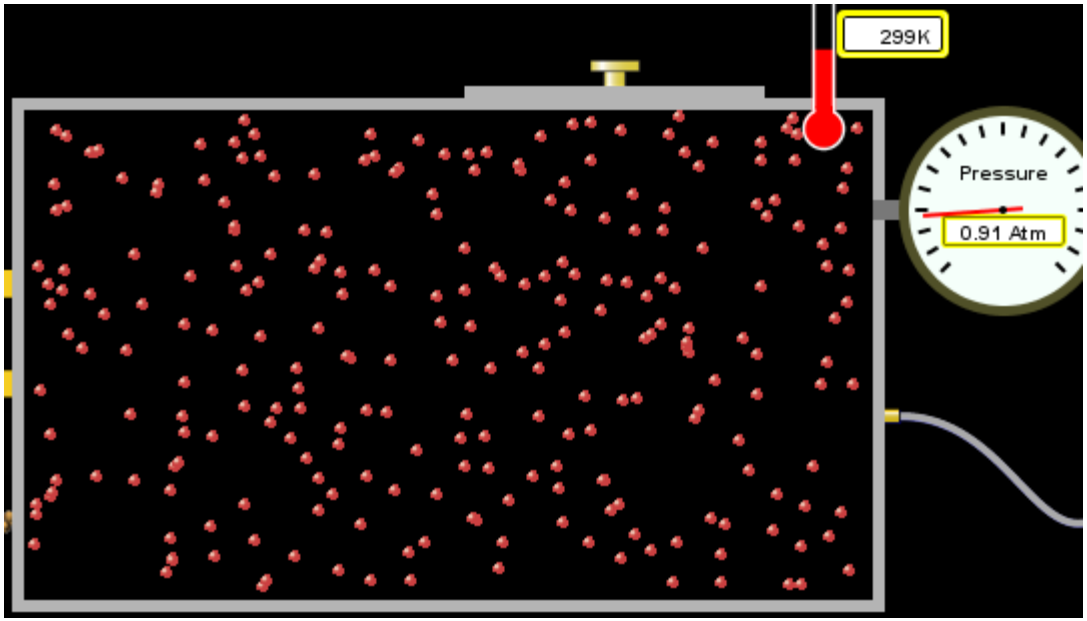
1. There are 2 balloons in a room. They are identical in size and material. One balloon is filled with air and the other balloon is filled with Helium. How does the pressure of the air balloon compare to the pressure of the Helium balloon. The pressure in the air balloon is

A. less B. equal C. greater





For expandable container, set pressure constant



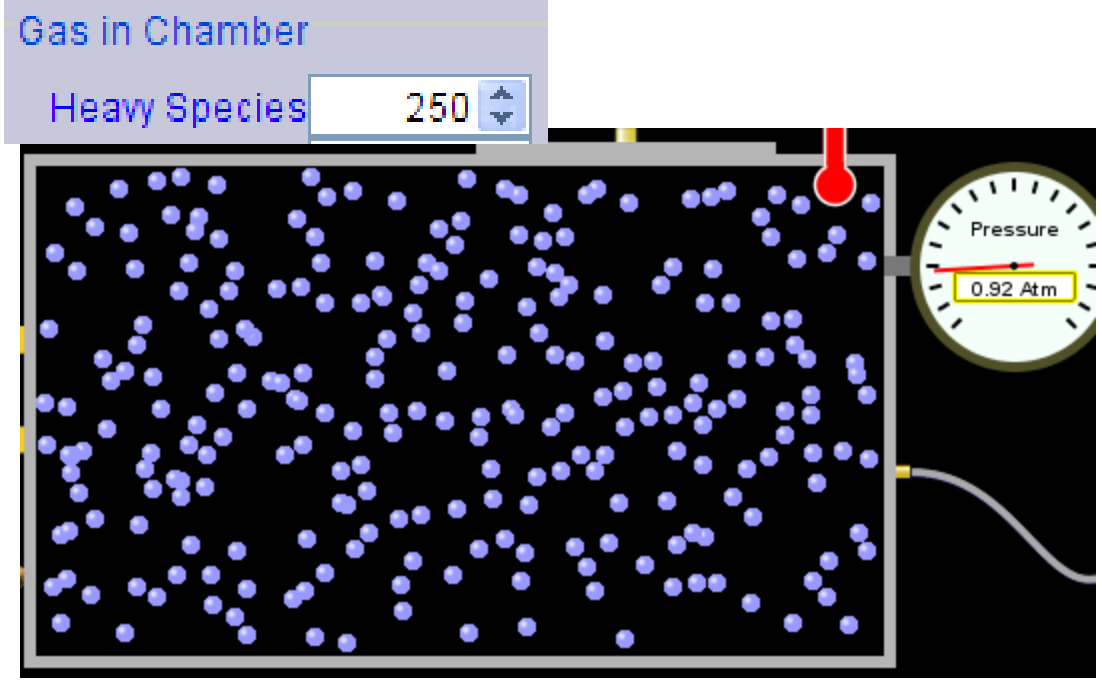
answer

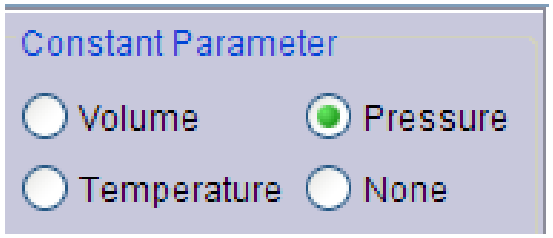
2. How does the pressure in the Helium balloon compare to the pressure of the air in the room? The pressure in the Helium balloon is

A. less B. equal C. greater

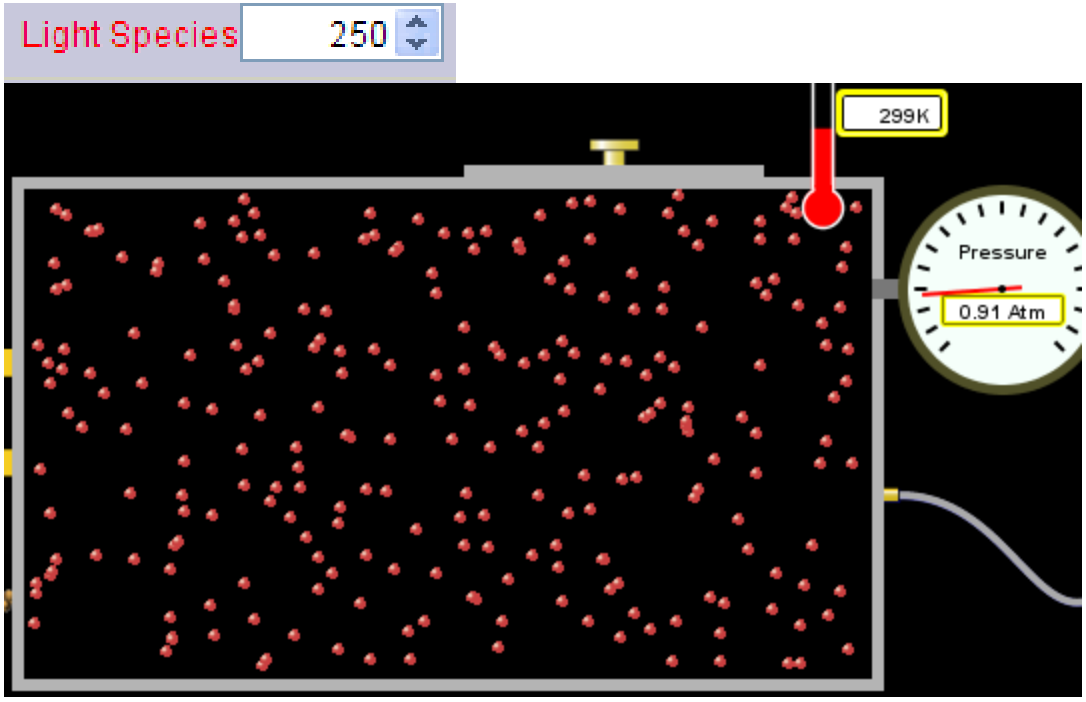
3. How do the number of air molecules in the air balloon compare to the number of He atoms in Helium balloon?
The number of air molecules is

A. less B. equal C. greater





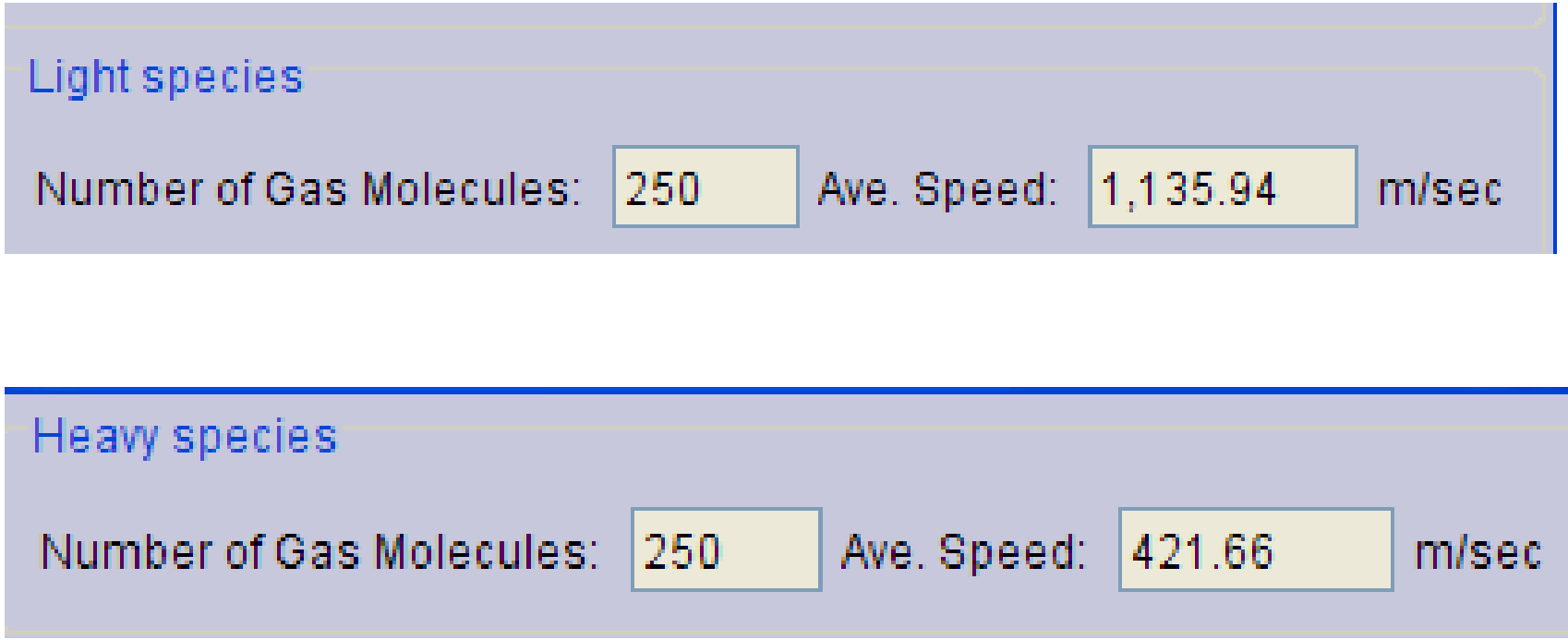
For expandable container, set pressure constant



answer

4. How does the average speed of the Helium molecules compare to that of the air molecules?
The average speed of the He molecules is

A. less B. equal C. greater


Light species
Number of Gas Molecules: 250
Ave. Speed: 1,135.94
m/sec
Heavy species
Number of Gas Molecules: 250
Ave. Speed: 421.66
m/sec

Answer to 4

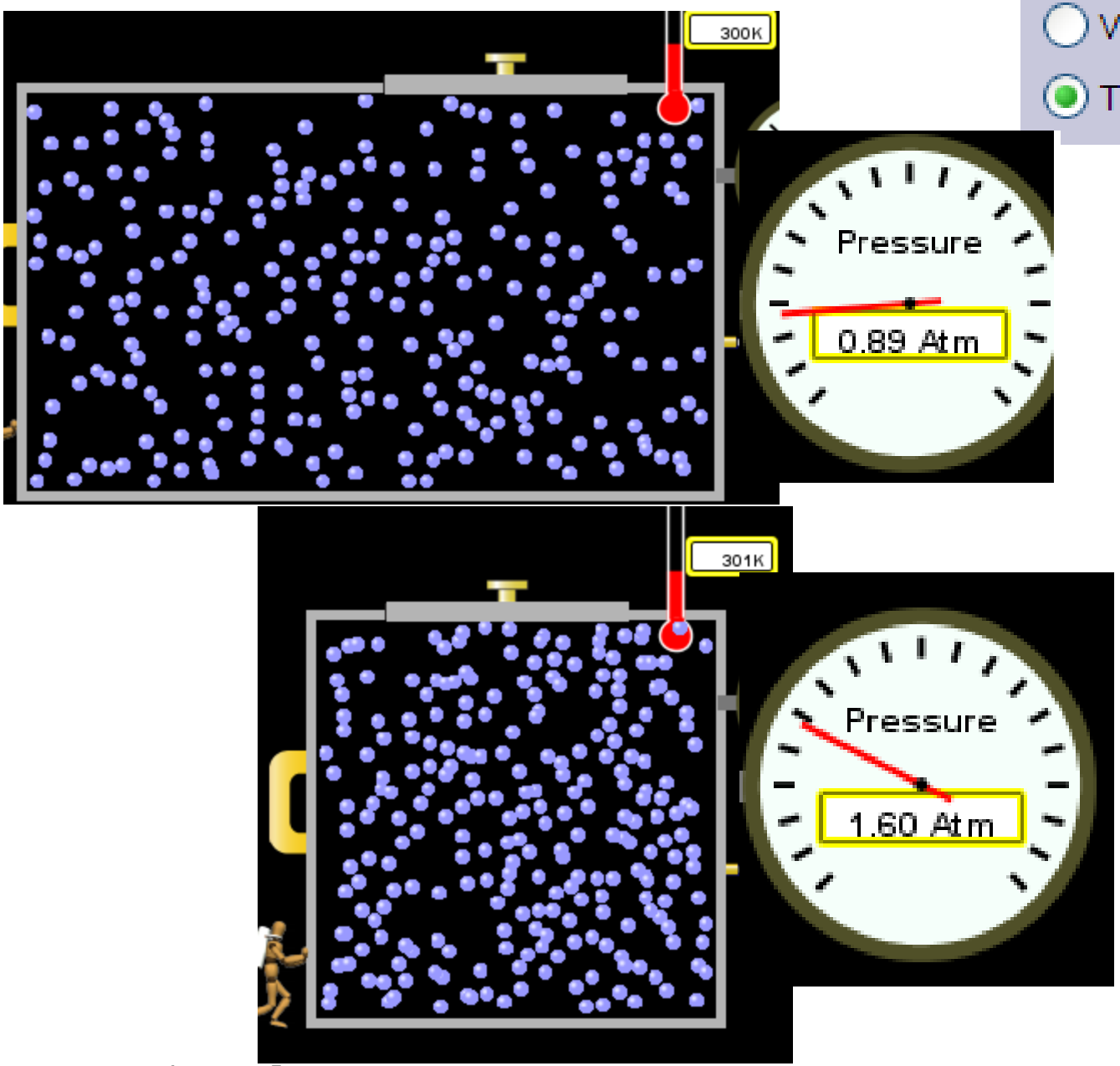
Look at the animation of the particles bouncing around in the volume. Describe what visual information you can use to get a sense of the pressure that the gas particles are exerting on the walls.

Why does the pressure reading vary with time?

What **visual** cues are associated with an increase in pressure?

5. What will happen to the pressure if temp is held constant and the volume is decreased?

A. **Pressure goes up because more collisions**
B. **Pressure goes up because more collisions are happening, but same force per collision**
C. **Pressure goes up because more collisions are happening, and increased force per collision**
D. **Nothing because pressure is only related to molecular speed**


Constant Parameter
Volume
Pressure
Temperature
None
300K
Pressure
0.89 Atm
301K
Pressure
1.60 Atm

Answer to 5

14.7psi=1atm

The next slides follow the activity

Understanding physical change of gases *continues*

Learning Goals:

- **Describe a molecular model of gas pressure**
- **Describe what happens to the measurable quantities if changes to the gas system are made.**
- **Make sense of the measurable quantities of gases by analyzing examples of macroscopic things that are similar**
- **Explain using physics what is happening on a molecular level when changes are made to a gas system.**

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6. You are flying from Denver to Boston, and you bring along a ½ full bottle of shampoo that was well sealed before you left Denver. You land in Boston and proceed to your hotel. The number of air molecules within the shampoo bottle:

A. **has decreased**

B. has stayed the same

C. has increased

7. If the walls of the shampoo bottle are strong and rigid so that the bottle has the same shape as before you left, how does the pressure of the air inside the bottle compare to the pressure of the air in Denver?

A. less than

B. equal to

C. greater than

8. How does the pressure inside the bottle compare to the pressure of the air in Boston?

A. less than

B. equal to

C. greater than

9. If you had a water bottle with very soft sides. When you open your suitcase in Boston, the bottle would look

A. squished

B. same size

C. puffed out

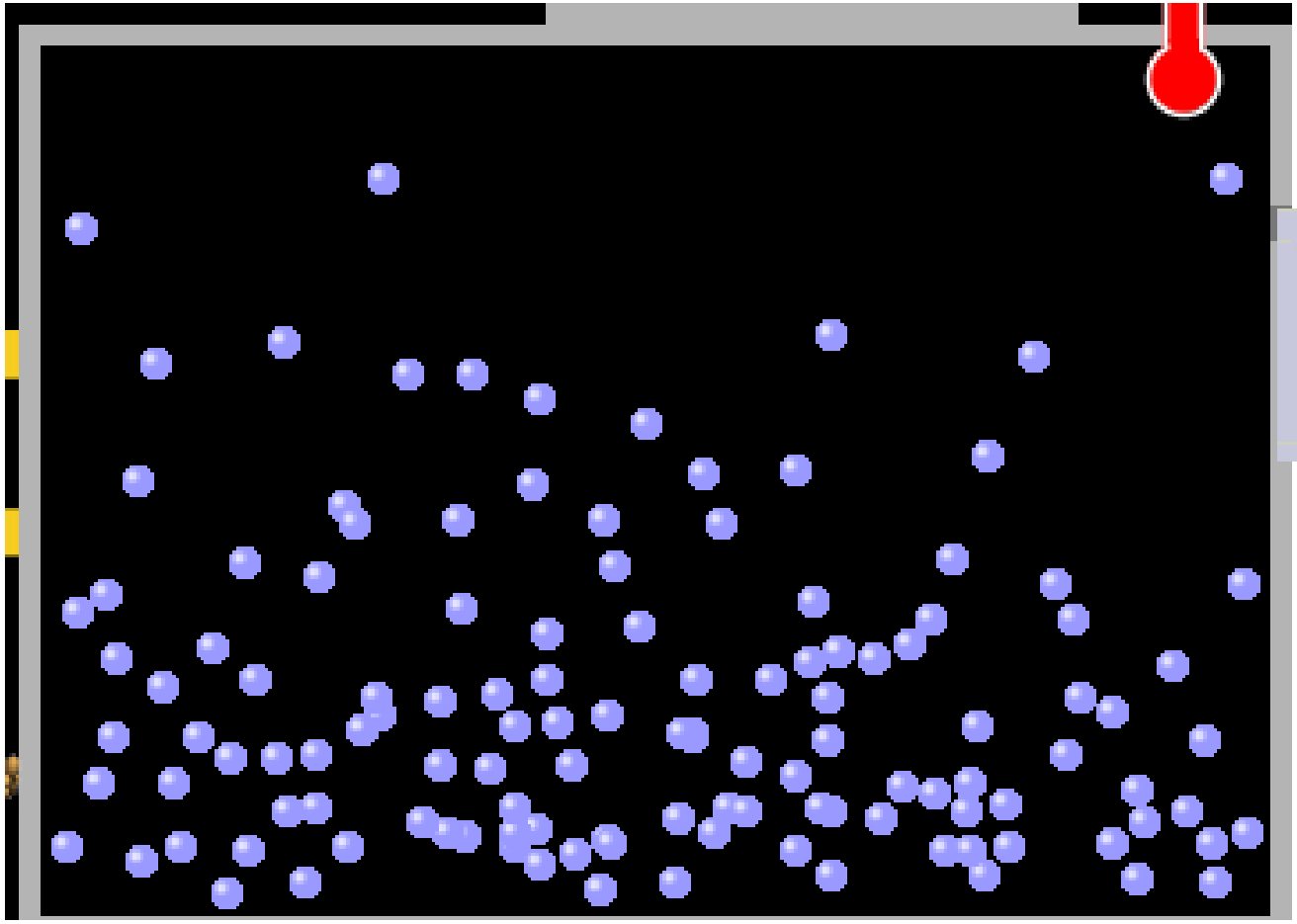
What effects pressure for ideal gases?

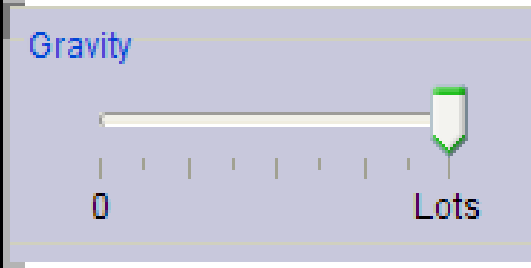
- Temperature
- Number of particles
- Volume
- Mass of particles doesn’t effect pressure (Avogadro’s Principle)

Slides for next day

People who climb the tallest mountains in the world often use oxygen tanks to help them breathe. If a mountain climber asked you to explain the physics behind the “thin air”, what would you say to him?

Gravity concentrates air closer to sea level





If you are in a building fire, you are supposed to lie on the ground. Why?

If you are hiking in the mountains and find yourself short of breath, do you think if you lie on the ground you could breathe easier?

Review of KMT
PhET sims: Friction, States of Matter and Gas Properties

This is for College Chemistry for students who have already taken College Physics and completed the KMT inquiry lesson. The learning goals are from that lesson

http://phet.colorado.edu/teacher_ideas/view-contribution.php?contribution_id=765

Also uses Molecules 360 by Chem Ed DL

Have *Friction, States of Matter* and *Gas Properties* and Molecules 360 all running before class starts

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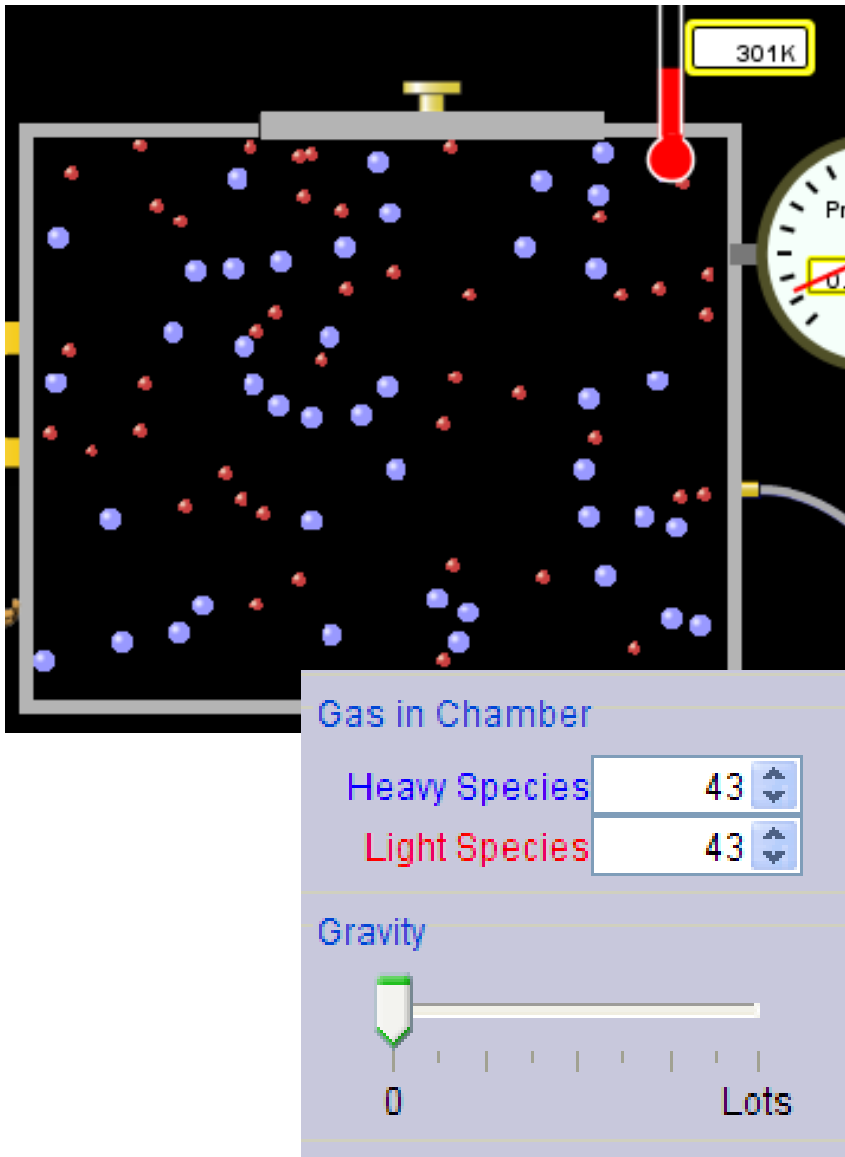
Learning Goals:

- **Students will be able to describe matter in terms of molecular motion. The description should include**
- **Diagrams to support the description.**
- **How the particle mass and temperature affect the image.**
- **What are the differences and similarities between solid, liquid and gas particle motion**
- **How the size and speed of gas molecules relate to everyday objects**

Rub your hands together. What does friction do to molecules?

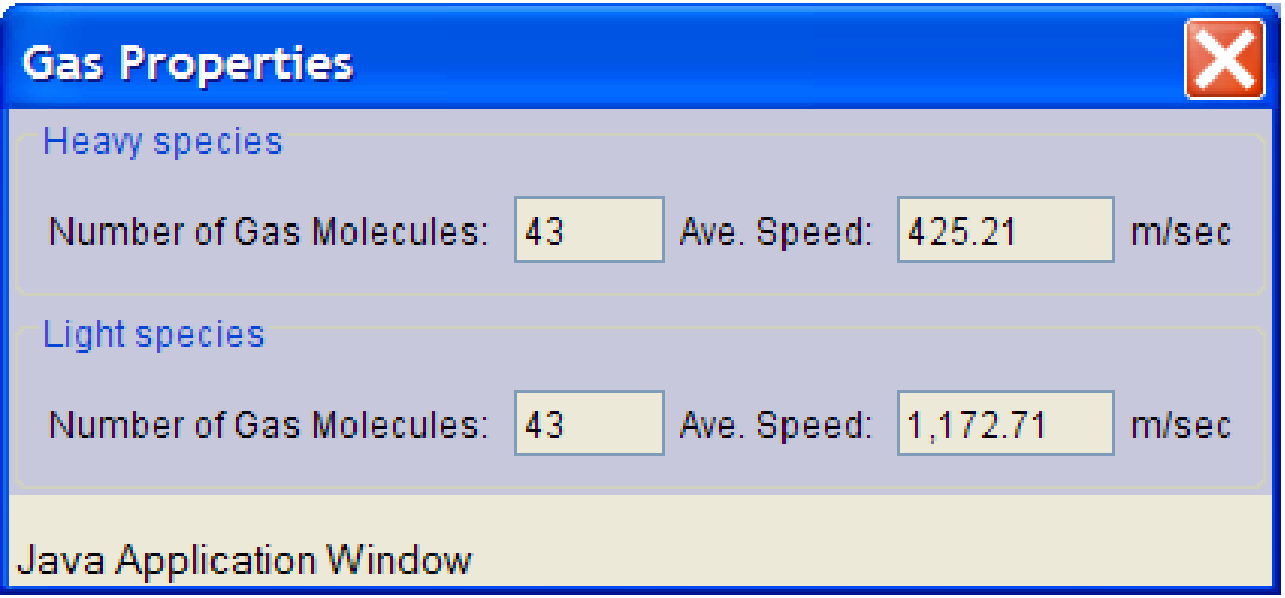
- Draw your ideas

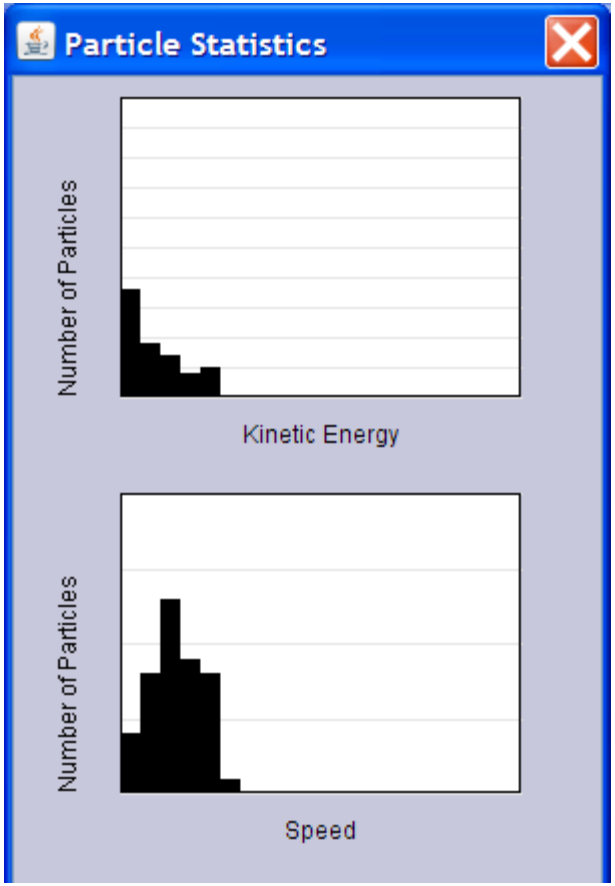
If you have a bottle with Helium & Nitrogen at room temperature, how do the speed of the particles compare?



A. All have same speed
B. The average speeds are the same
C. Helium particles have greater average speed
D. Nitrogen particles have greater average speed

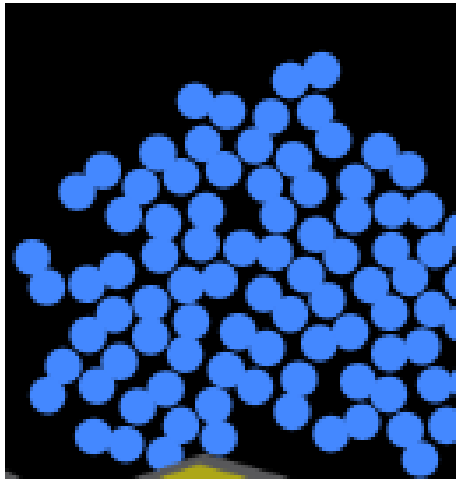
Light and heavy gas at same temperature 300K



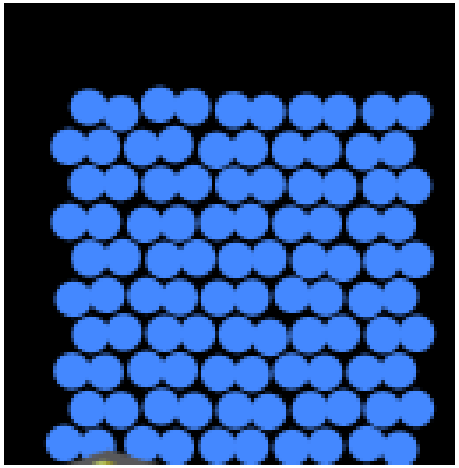


Speed of each particle varies!!

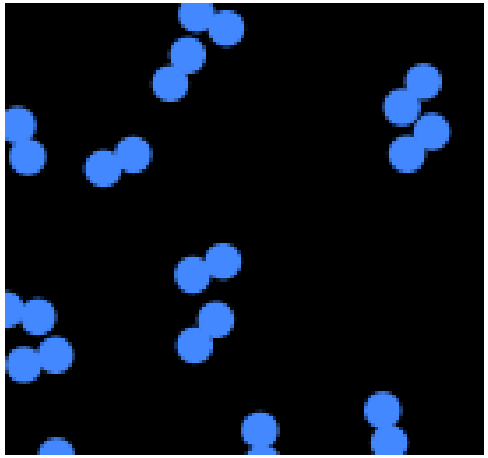
Which is most likely oxygen gas?



A

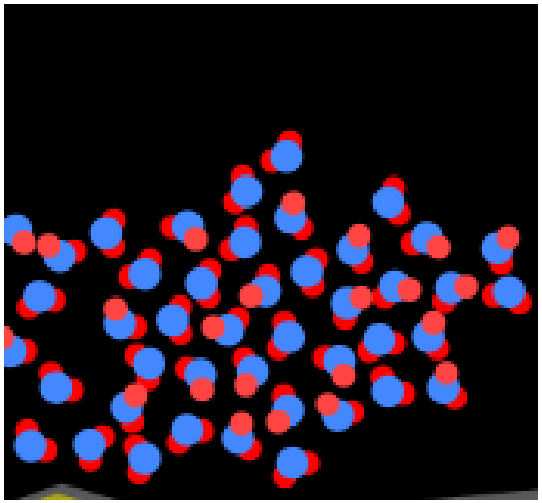


B

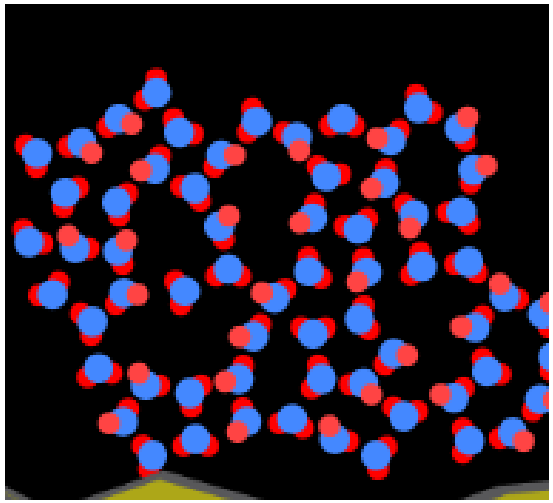


C

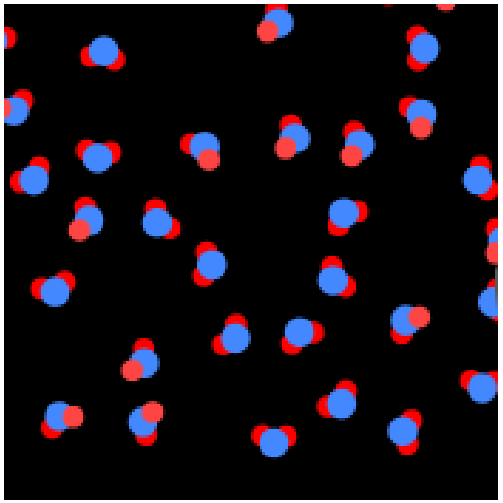
Which is most likely liquid water?



A

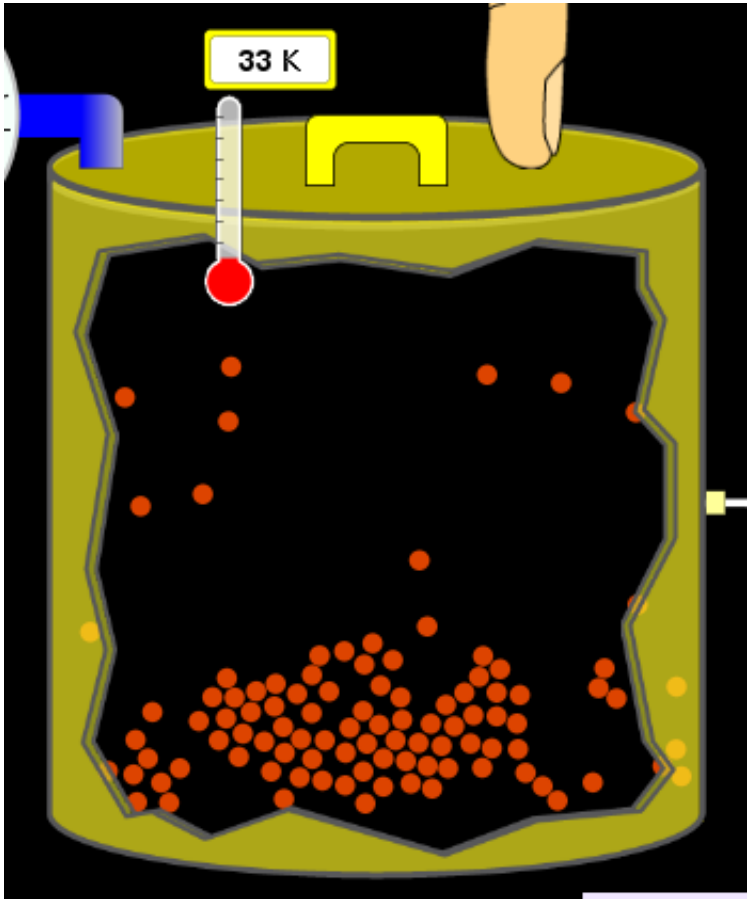


B



C

How could material be the same temperature and yet have different Phase?



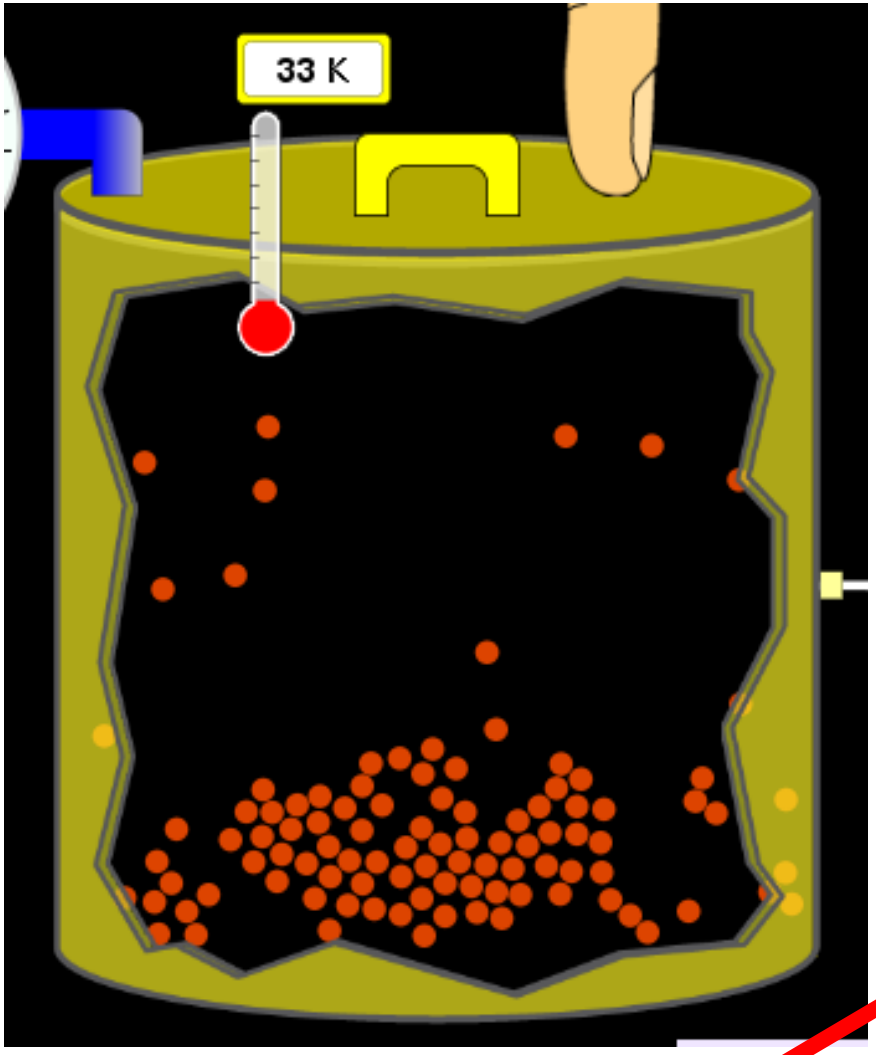
Neon

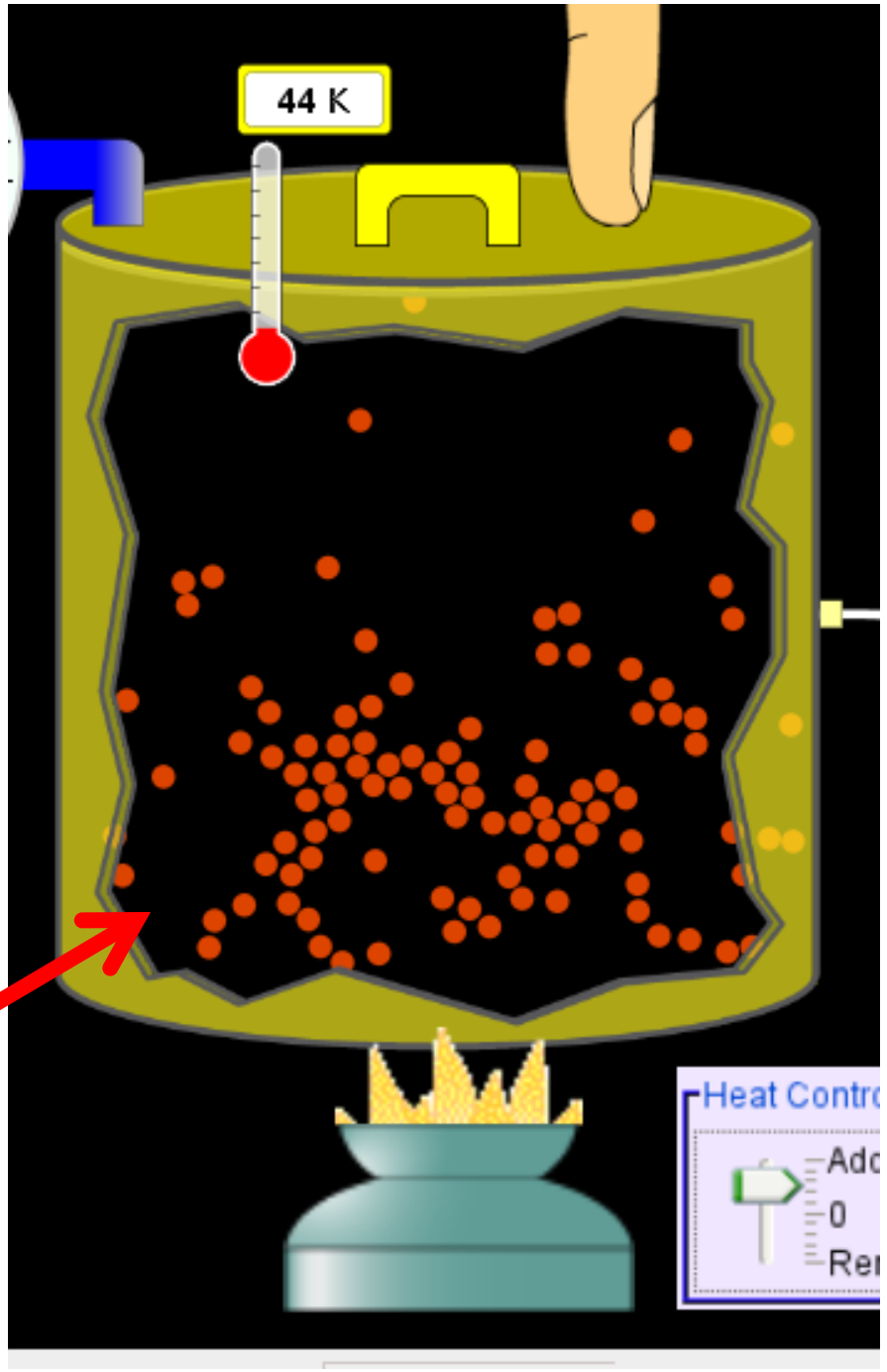
Liquid-Gas

Like water-water vapor in a water bottle

What happens if you add energy using the heater?

A. No change other than all atoms speed up
B. More atoms would condense
C. More atoms would evaporate





More are gaseous

KMT summary:

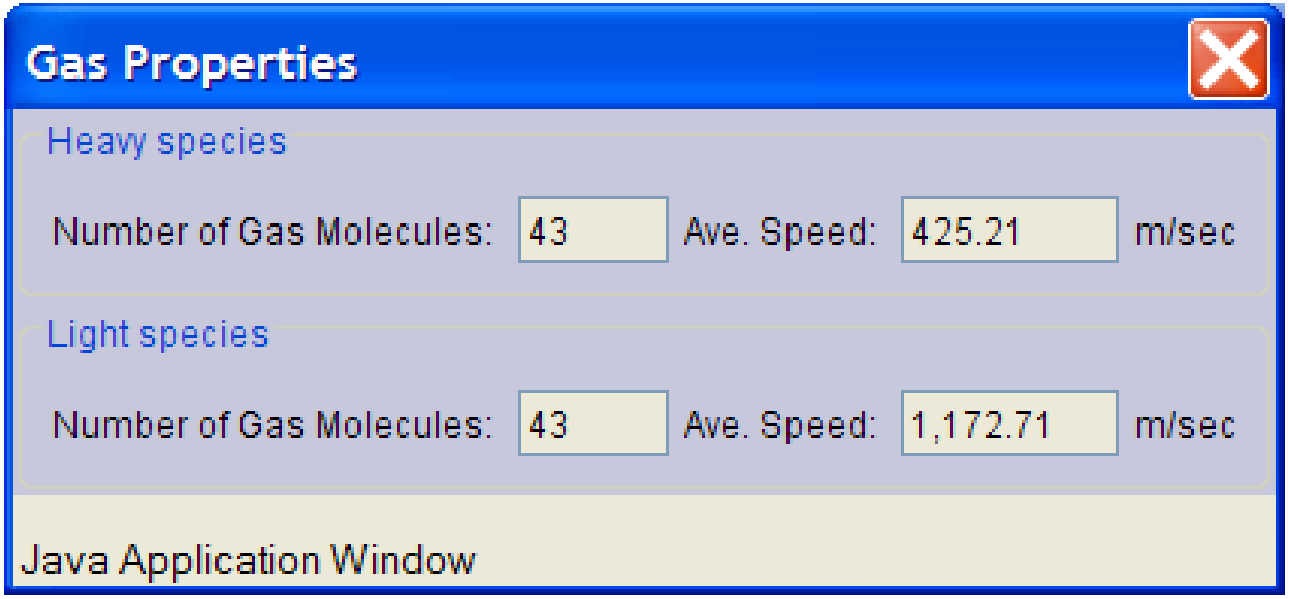
- Matter is made up of particles having negligible mass are in constant random motion (vibrate, rotate, translate)
- The particles are separated by great distances
- The particles collide perfectly elastically (there are no forces acting except during the collision)
- The temperature of a substance is related to the molecular velocity.

To show vibration

- http://chemeddl.org/collections/molecules/index.php
- Check **Spin Molecule** to see 3D rotation
- Show vibration under **Normal modes of vibration** (toggle down to see bond length changing)

An air particle travels about ___ as fast as a car on the highway.

60 mph is about 26m/s



How many water molecules are in a raindrop(.5 cm diameter). *The molecules are about .1nm*

If we just look at how many are across .05m/.1E-9m = 5E7 or 50 million.

Salts and Solubility

Clicker questions for 5 actvitites

Each set of clicker questions and the activity can be downloaded from the Teaching Ideas database at PhET

by Trish Loeblein updated July 2008

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Salts and Solubility Activity1

Learning Goals Students will be able to:

- Determine the chemical formula by observation of ionic ratios in solutions
- Relate the simulation scale to real lab equipment through illustration and calculations
- Predict the chemical formula of compounds with a variety of ion charge combinations

Trish Loeblein July 2008 Questions 1-3 are a pretest. 4-8 are reflective

1. Which is the formula for the compound made from M^{+1} and N^{-2}

   A. MN_2

   B. M_2N

   C. MN

   D. M_2N_2

2. Which is the formula for the compound made from M^{+3} and N^{-1}

A. MN_3

B. $M_3\ N$

C. MN

D. $M_3\ N_3$

3. Which is the formula for the compound made from M^{+3} and N^{-2}

A. MN

B. $M_3 N_2$

C. $M_2 N_3$

D. $M_6 N_6$

4. I thought this lab was _____ USEFUL for learning about ionic formulas.

A. very

B. mostly

C. barely

D. not

5. I thought this lab was _____ ENJOYABLE for learning about ionic formulas.

A. very

B. mostly

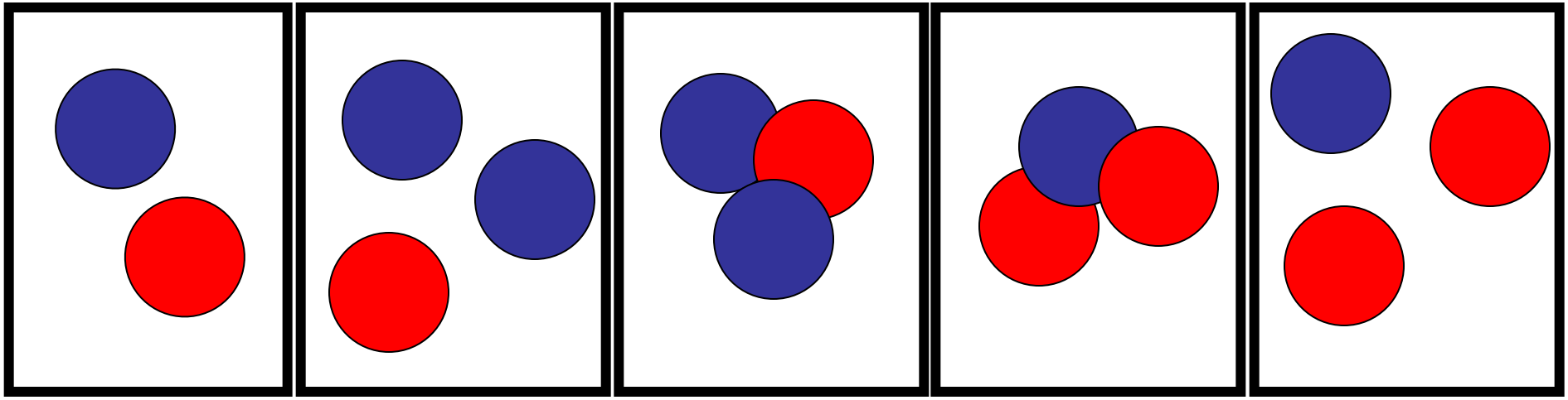
C. barely

D. not

6. Which is the best drawing for Magnesium chloride in a water solution?

Mg

Cl

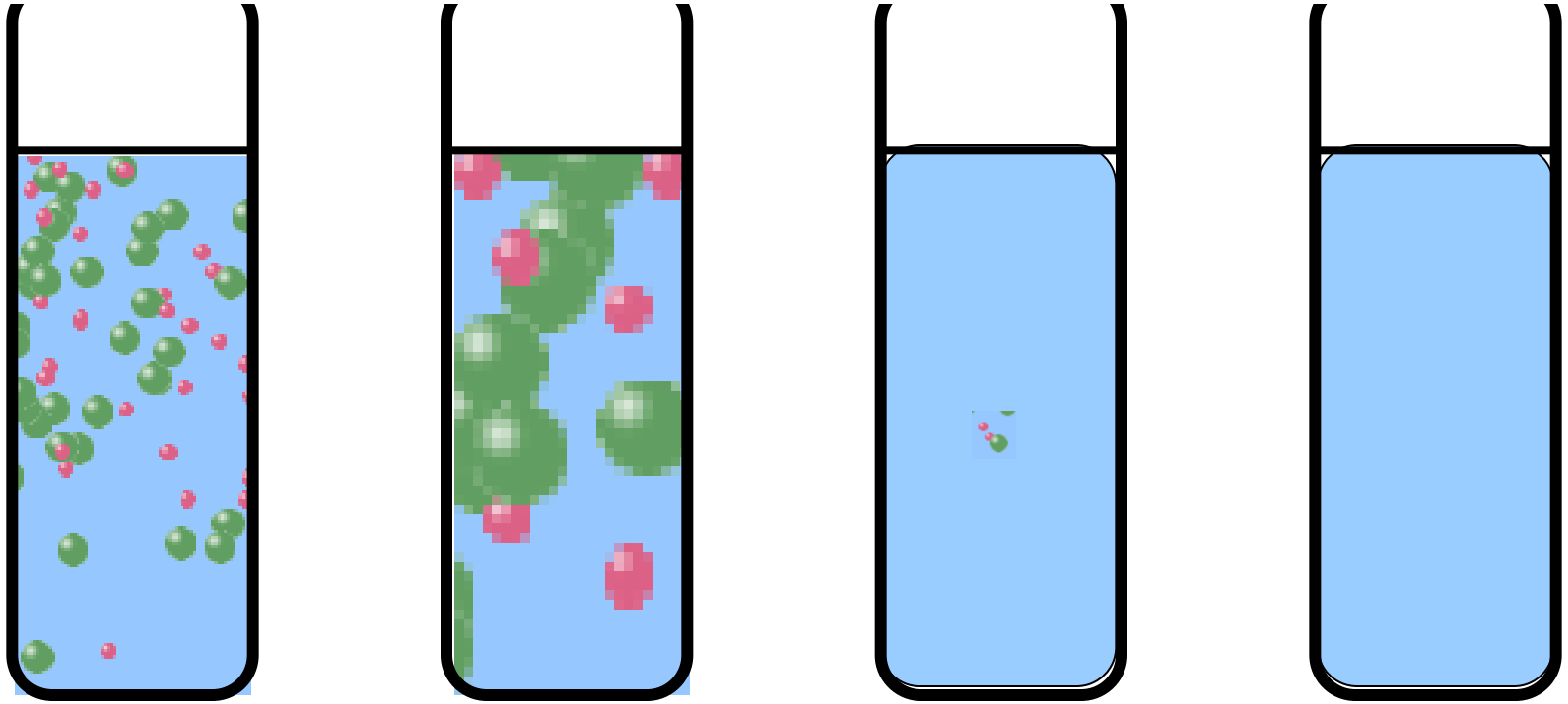


A B C D E

7. How would the drawing change if Magnesium chloride were changed to Magnesium oxide?

A. The ratio of the ions would be the same
B. The ratio would change to 1 magnesium for every oxide
C. The ratio would change to 2 magnesium for every oxide
D. You would have to use different colors

8. Which drawing best represents how large ions should be drawn in a 5 ml test tube of water?



Salts and Solubility Activity 2

Learning Goals: Students will be able to:

- Write the dissolving reaction for salts
- Describe a saturated solution microscopically and macroscopically with supporting illustrations
- Calculate solubility in grams/100ml
- Distinguish between soluble salts and slightly soluble salts macroscopically.

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1. Which is correct for dissolving barium iodide in water ?

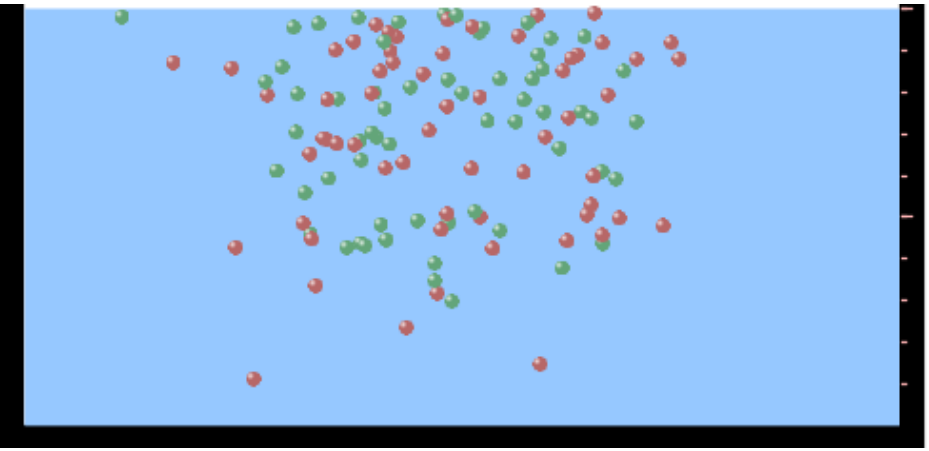
A. $BaI_{2(s)} \rightarrow Ba_{(aq)} + 2I_{(aq)}$

B. $BaI_{(s)} \rightarrow Ba_{(aq)} + I_{(aq)}$

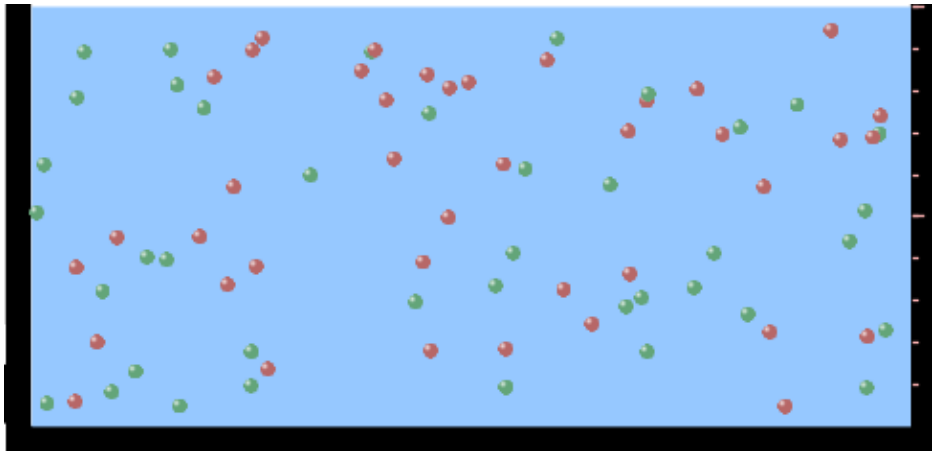
C. $BaI_{2(s)} \rightarrow Ba^{+2}_{(aq)} + 2I^{-}_{(aq)}$

D. $BaI_2 \rightarrow Ba^{+2} + 2I^{-}$

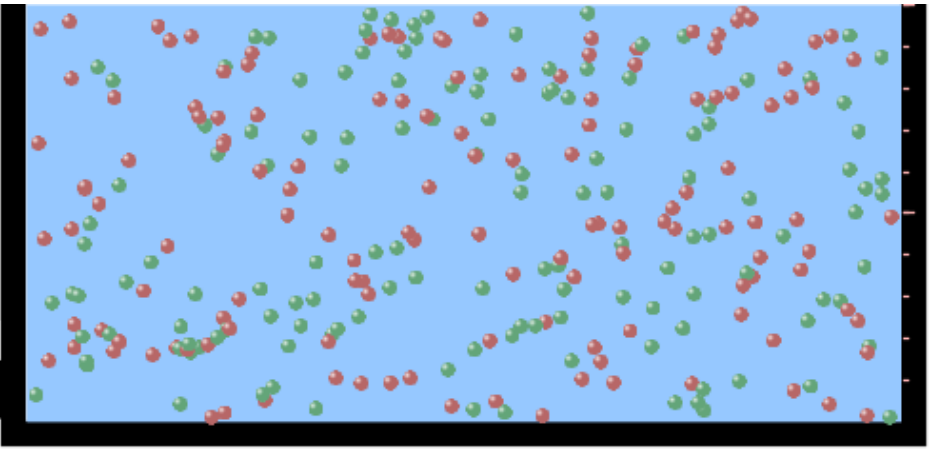
2. Sue used *Salts* to learn about “saturated solution”. Which image best shows a saturated solution?



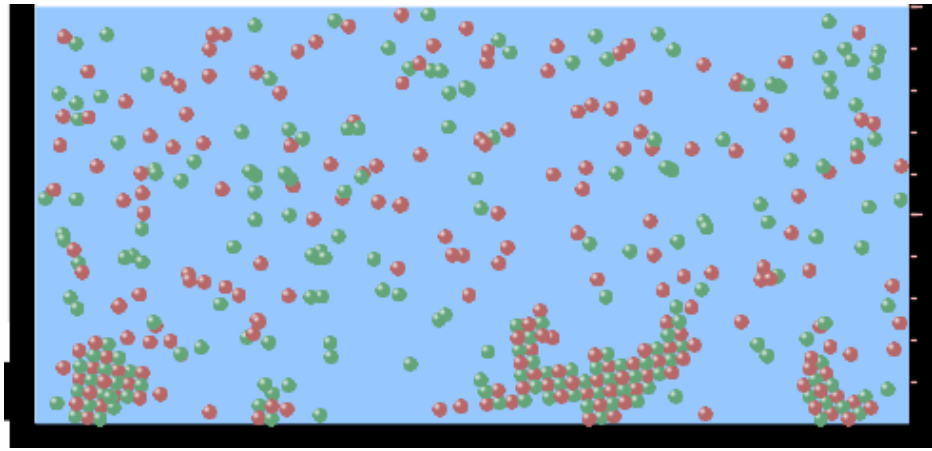
A



B

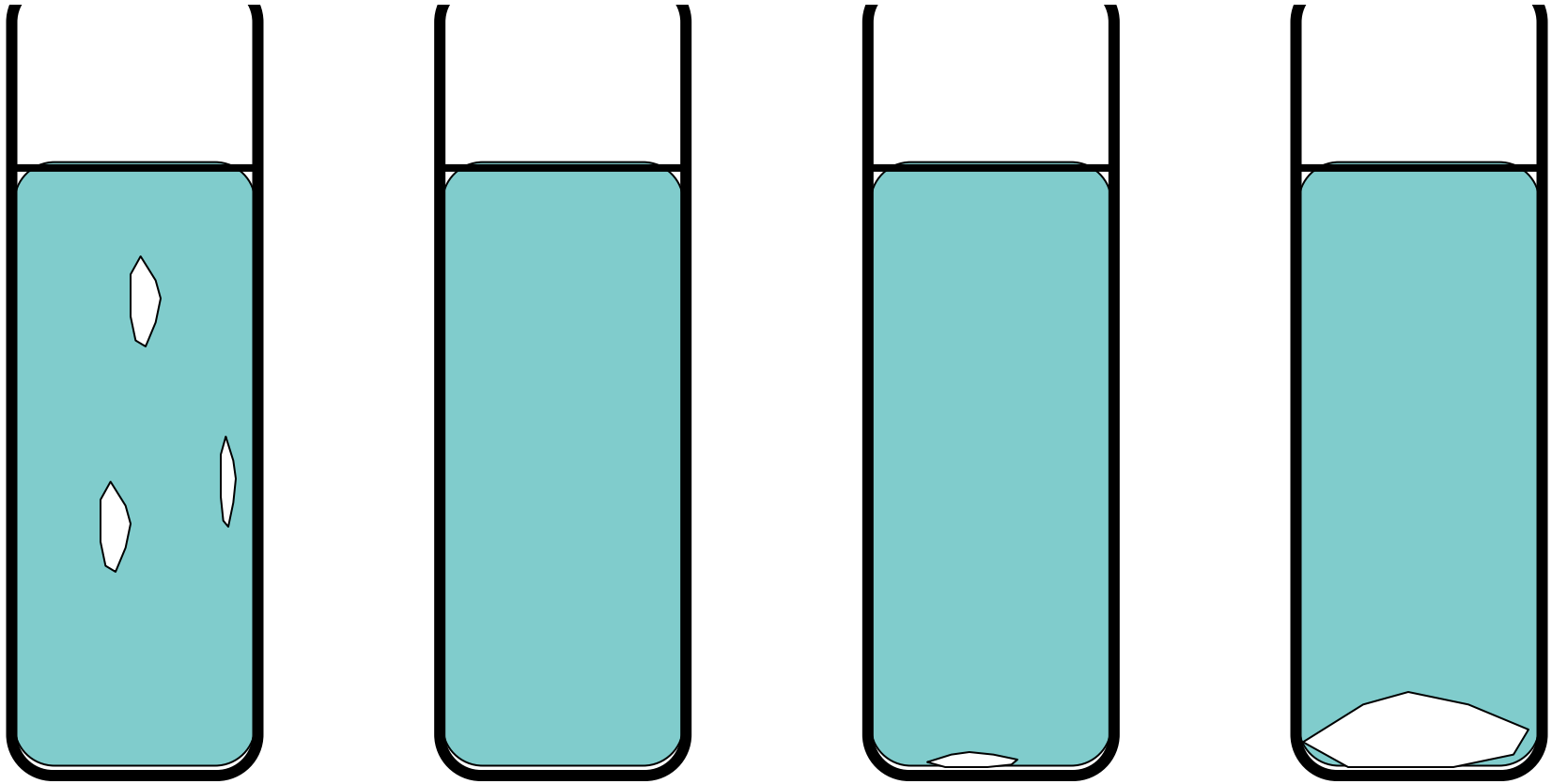


C



D

3. Waldo added salt to a test tube of water to learn about “saturated solution”. Which image best shows a saturated solution?



4. If you used the sim to test silver chloride, you would see 80 Ag^+ ions dissolved in 1E-17 liters. What is the solubility in 100 ml of water?

A. .0019 grams/100 ml water

B. .00019 grams/100 ml water

C. .0024 grams/100 ml water

D. .00024 grams/100 ml water

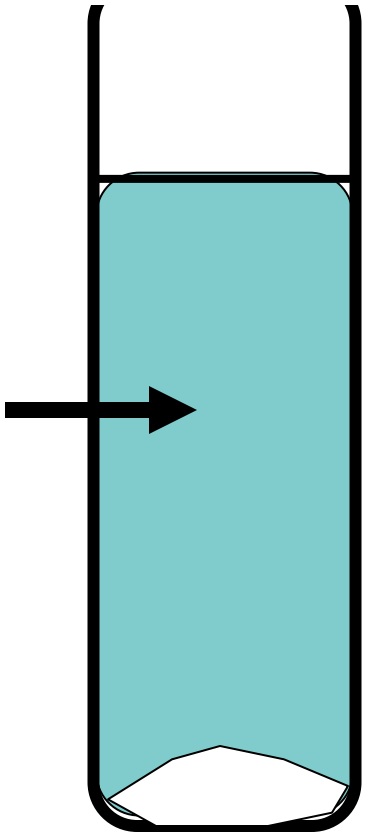
The calculation for AgCl example:

80 AgCl /6.02E23 AgCl/mole)
*(178.8grams/mole)
= 2.4E –20 grams

2.4E –20 grams/(1E-17L) = .0024 grams/L

.0024 grams/L* .1L/100ml=.00024 g/100ml

5. You knew a salt was either sodium chloride or silver chloride. If you put **1** gram in 10 ml of water in a test tube, and it looked like this



Which is it?

A. Sodium chloride

B. Silver Chloride

C. This is not an identifying test

6. How a drawing for Magnesium oxide be different from Magnesium chloride?

A. The ratio would be the same, but the balls would be connected
B. The ratio would change to 1 magnesium for every oxide and balls would be separate
C. The ratio would change to 1 magnesium for every oxide and balls connected
D. The ratio would change to 2 magnesium for every oxide and balls connected

Salts and Solubility Activity 3

Solution Equilibrium and K_{sp}

Learning Goals: Students will be able to:

- Describe the equilibrium of a saturated solution macroscopically and microscopically with supporting illustrations. (not covered in these questions)
- Write equilibrium expressions for salts dissolving
- Calculate K_{sp} from molecular modeling.

Trish Loeblein updated July 2008

I simplified the reactions by omitting (aq), my students have found this helpful and they know that they must put it on tests.

1. Table salt dissolves in water:

$NaCl(s) \rightleftharpoons Na^+ + Cl^-$

What is the correct K_{sp} expression if s is the molar solubility Sodium chloride?

a. $K_{sp} = s^2$

b. $K_{sp} = 2s^2$

c. $K_{sp} = s^5$

d. $K_{sp} = 4s^4$

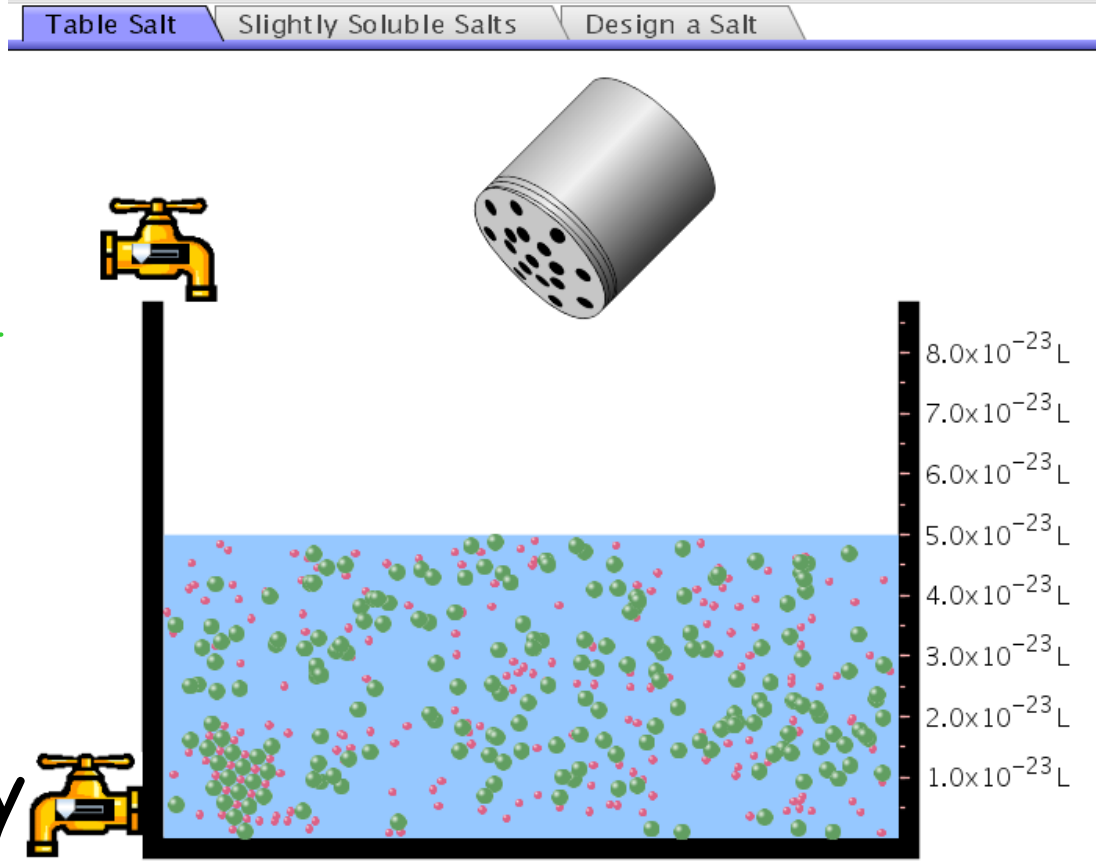


Table salt dissolves in water:

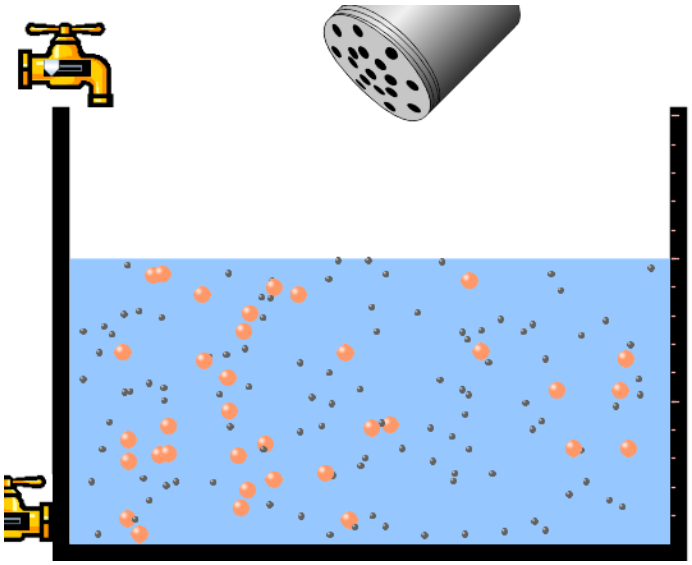
$NaCl(s) \rightleftharpoons Na^+ + Cl^-$

$K_{sp} = [Na^+]\,[Cl^-]$

For every NaCl molecule that dissolves there was one Na^+ and one Cl^- put into solution, so if we let s equal the amount of NaCl that dissolved then the expression substitutes to be $K_{sp} = s^2$

2. Silver arsenate dissolves in water:

$Ag_3AsO_4(s) \rightleftharpoons 3\ Ag^+ + AsO_4^{3-}$



What is the correct K_{sp} expression if s is the molar solubility Silver arsenate?

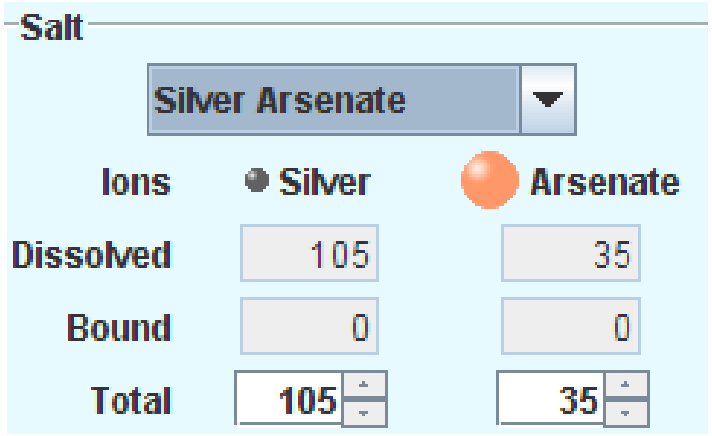
a. $K_{sp} = s^2$

b. $K_{sp} = 3s^2$

c. $K_{sp} = s^4$

d. $K_{sp} = 3s^4$

e. $K_{sp} = 27s^4$



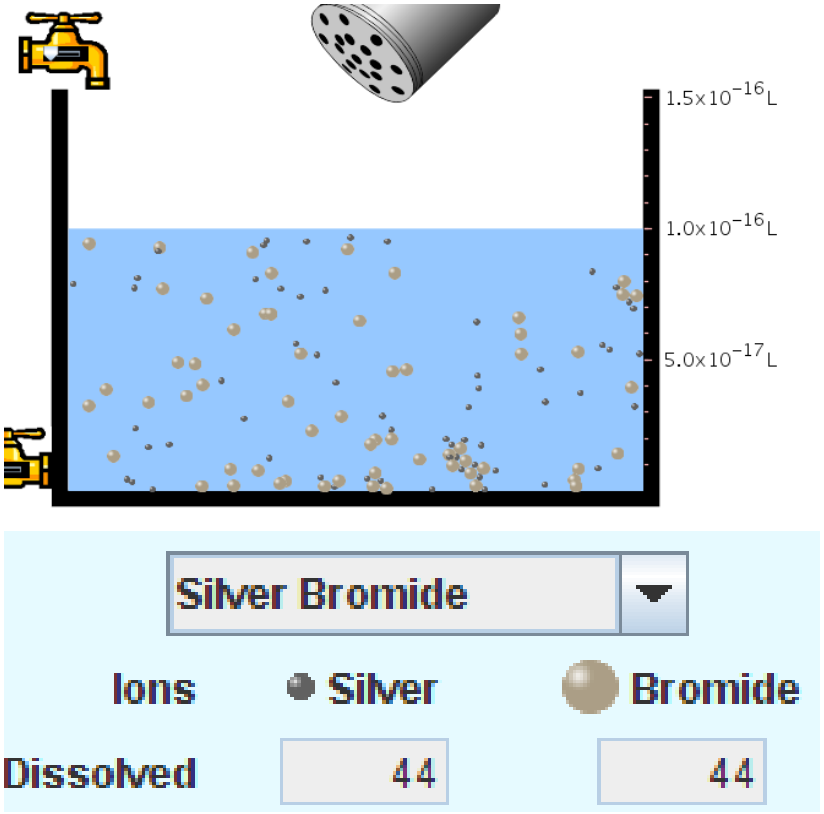
3. What is the proper expression for the molar solubility **s** of **AgCl** in terms of K_{sp}?

a. $s = K_{sp}$

b. $s = (K_{sp})^2$

c. $s = (K_{sp})^{1/2}$

d. $s = K_{sp}/2$



$K_{sp} = [Ag^+][Br^-]$

$[Ag^+]=[Br^-]$ (44 of each are dissolved)

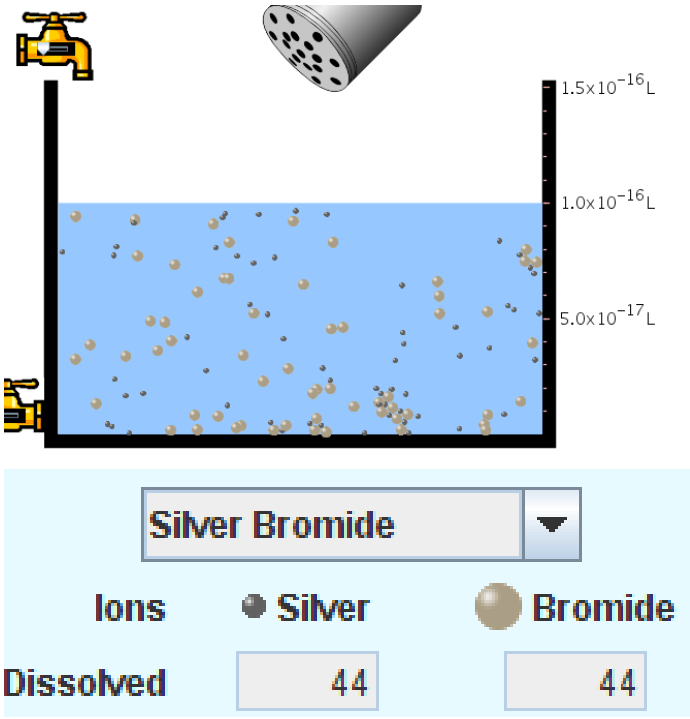
$K_{sp} = s^2$

$s = (K_{sp})^{1/2}$

Answer to previous slide

$AgBr \leftrightarrow Ag^+ + Br^-$ $K_{sp} = 5.0 \times 10^{-13}$

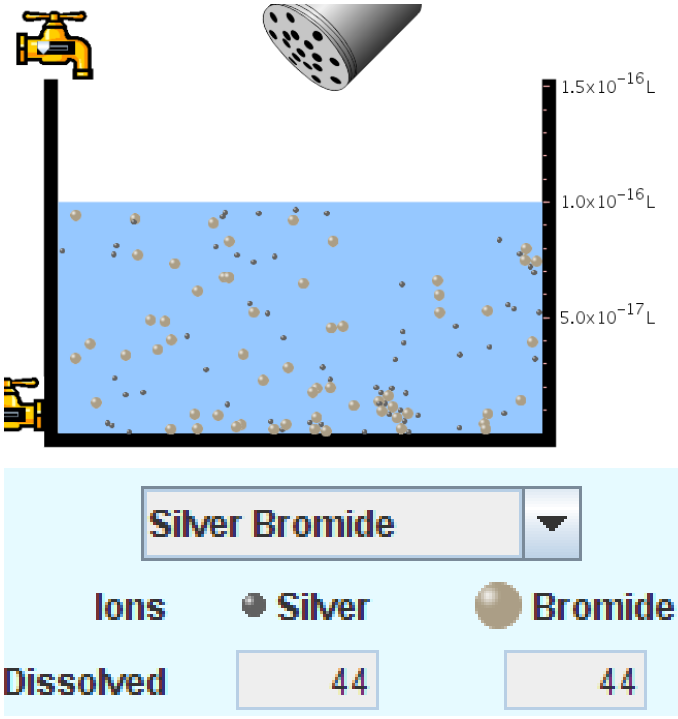
4. A saturated solution of AgBr in 1×10^{-16} liters of water contains about 44 Ag^+ and 44 Br^- ions as shown.
Suppose that K_{sp} were reduced to 2.5×10^{-13}. How many Ag^+ ions would you expect to see at equilibrium ?



a. 11 b. 22 c. 31 d. 44 e. 88

$AgBr \leftrightarrow Ag^+ + Br^-$ $K_{sp} = 5.0x10^{-13}$

Suppose that K_{sp} were reduced to $2.5x10^{-13}$. How many Ag^+ ions would you expect to see at equilibrium ?



$$s = \sqrt{Ksp}$$

$$= \sqrt{2.5x10^{-13}}$$

$$\approx 31$$

Answer to previous slide

5. Two salts have similar formulas XY and AB, but they have different solubility product constants.

XY: $K_{sp}= 1x10^{-12}$

AB: $K_{sp}= 1x10^{-8}$

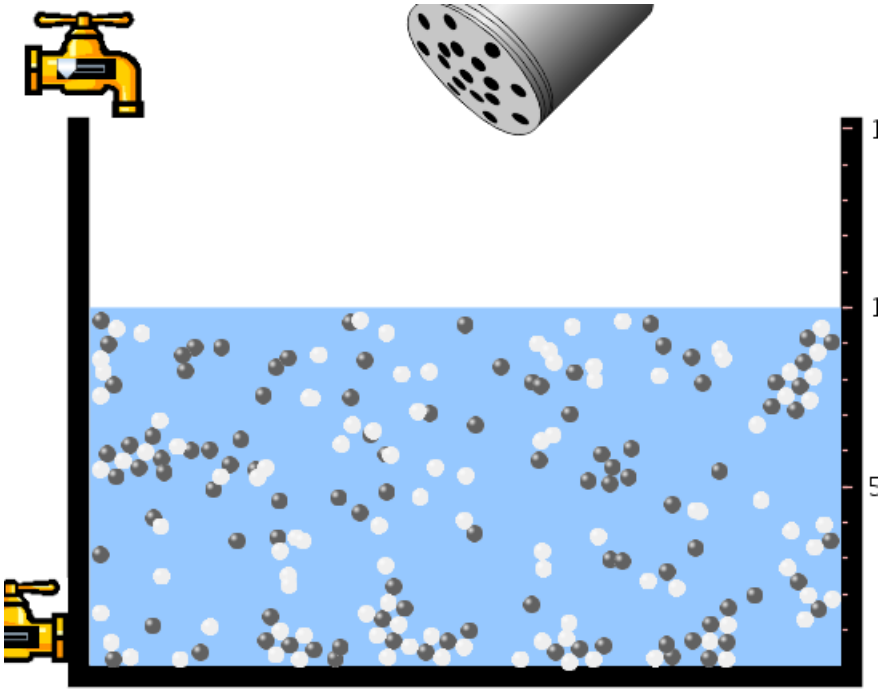
Which one would be more soluble?

A. AB

B. XY

C. The amount that dissolves would be the same.

D. Not enough information



6. Two salts have similar formulas XY and AB, but they have different solubility product constants.

XY: $K_{sp}= 1x10^{-12}$

AB: $K_{sp}= 1x10^{-8}$

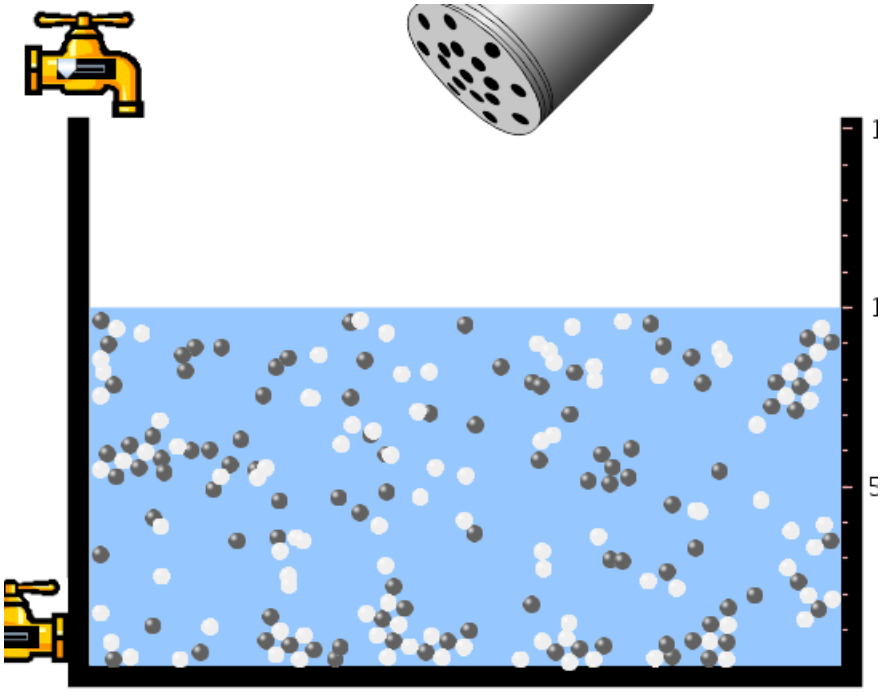
Which one would be more likely to precipitate?

A. AB

B. XY

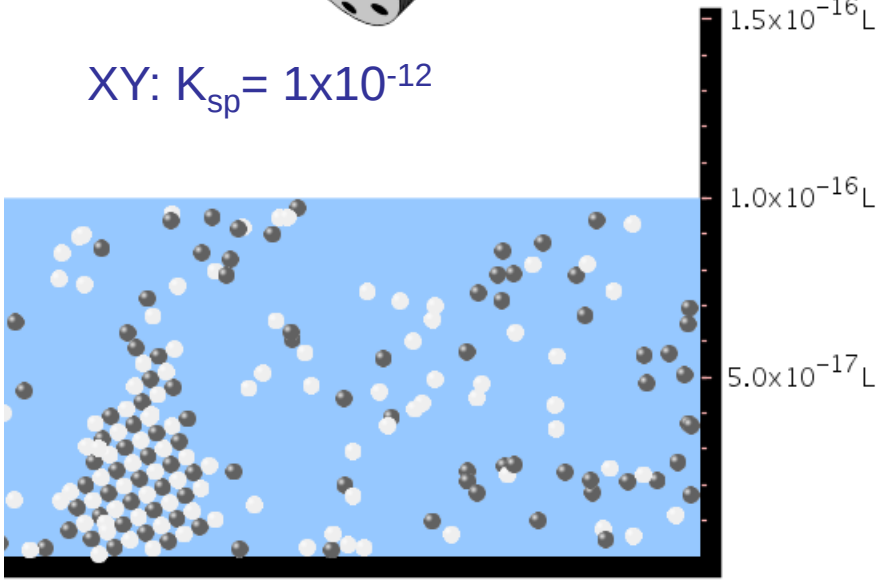
C. They behave the same

D. Not enough information



Slightly Soluble Salts | Design a Salt

XY: K_{sp}= 1x10^{-12}



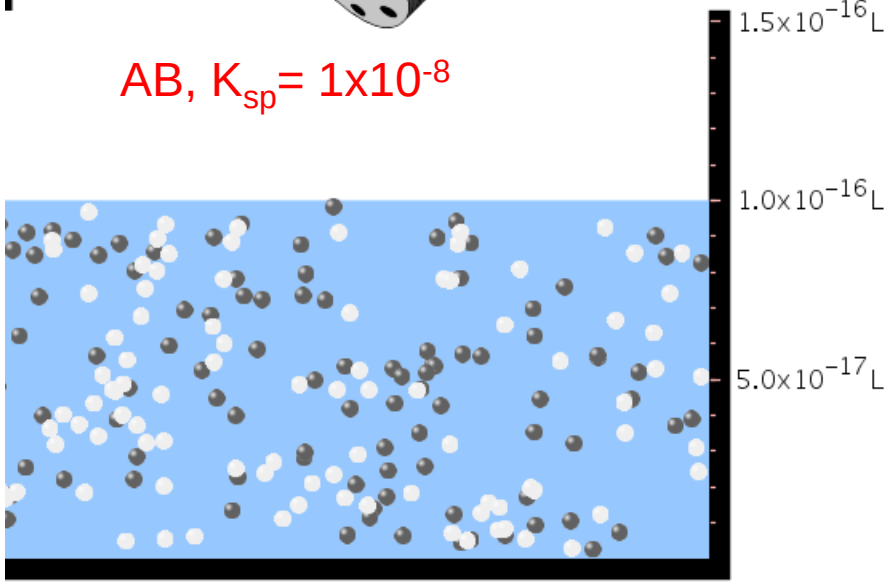
Salt
Cation charge: +1
Anion charge: -1
Ksp
1 E -12

Ions	Cation	Anion
Dissolved	60	61
Bound	40	39
Total	100	100

Water
Volume: 1.00E-16 liters (L)

Slightly Soluble Salts | Design a Salt

AB, K_{sp}= 1x10^{-8}



Salt
Cation charge: +1
Anion charge: -1
Ksp
1 E -8

Ions	Cation	Anion
Dissolved	100	100
Bound	0	0
Total	100	100

Water
Volume: 1.00E-16 liters (L)

Salts and Solubility Activity 4

The clicker questions do not directly address the goals because the are quantitative or have been well discussed by the group during the activities.

Learning Goals for 4: Students will be able to:

- Calculate Q.
- Predict what would be observed on a macroscopic level to a solution by comparing Q to K_{sp}.
- Use microscopic illustrations, to help explain the predictions.
- Use LeChatelier's Principle to predict how changing the amount of water will affect the solution.

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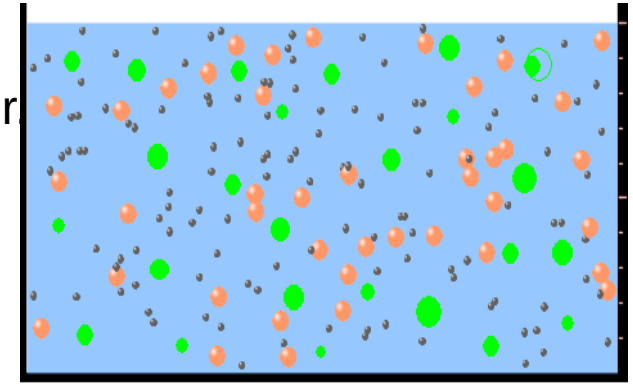
Two salts, XB and AB, are dissolved in a beaker of water. There are equal number of moles. They have different solubility product constants.



XB: K_{sp}= $1x10^{-12}$ AB: K_{sp}= $1x10^{-8}$

1. If you added B^- ions which would precipitate first?

A. AB

B. XB

C. They behave the same

D. Not enough information

2. 0.010 moles of $MgCl_2$ and 0.020 moles of $CuCl_2$ are dissolved in 0.10 liters of water. A solution of NaOH is slowly stirred in. Which precipitate forms first ?

$Cu(OH)_2$ $K_{sp} = 2.2 \times 10^{-20}$

$Mg(OH)_2$ $K_{sp} = 6.3 \times 10^{-10}$

a. $MgCl_2$ b. $CuCl_2$ c. $Mg(OH)_2$ d. $Cu(OH)_2$

Salts and Solubility Activity 5

Learning Goal for 5: Students will be able to predict what would be observed on a macroscopic and microscopic level for salts with varying ionic charge given the K_{sp}.

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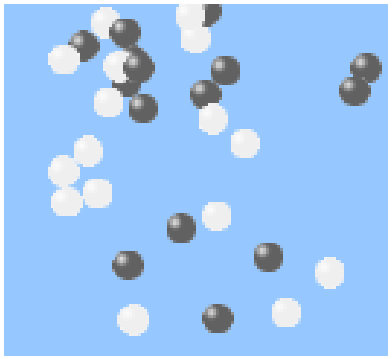
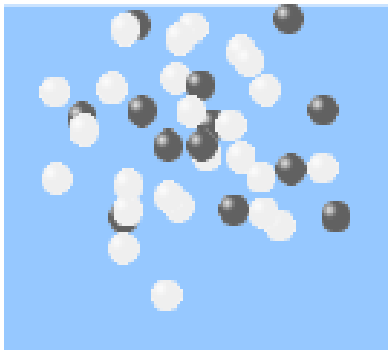
1. Which will have more dissolve particles in a saturated solution? K_{sp}=3 E – 13

   A compound made from

A. XY **B. XY_2** **C. no difference**

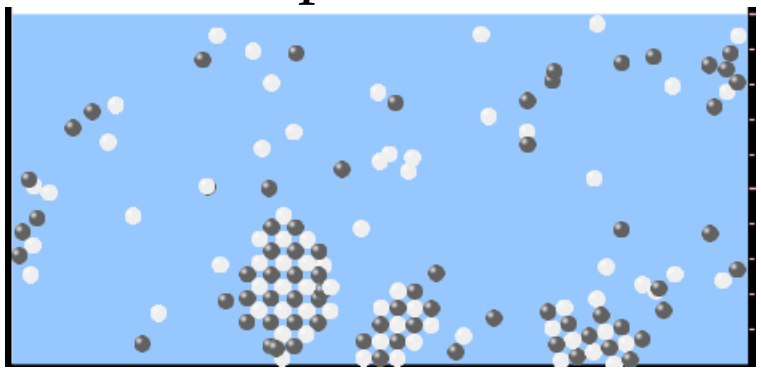




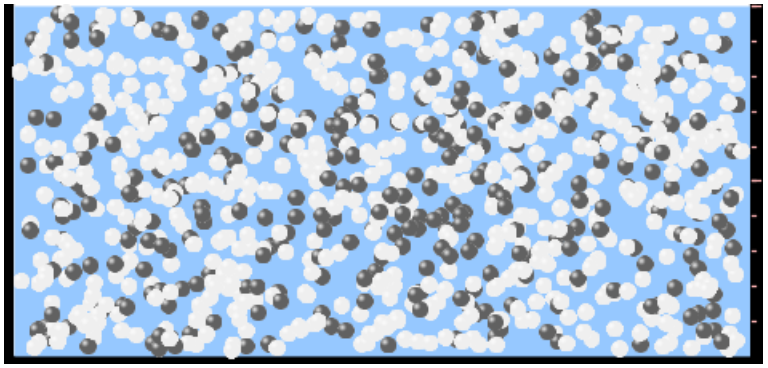
Answer to 1

$$A.K_{sp} = x^2; x = 5E-7$$

$$B.K_{sp} = (x)(2x)^2; x = 4E-5$$



XY



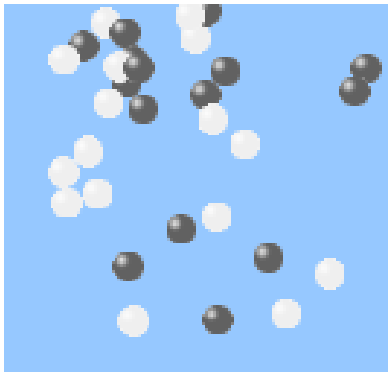
XY_2

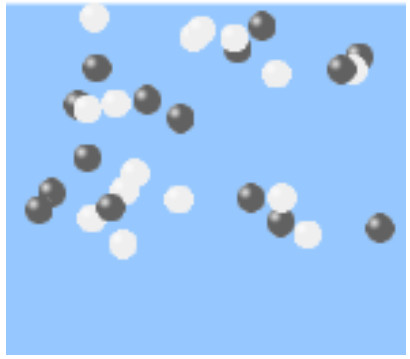
Why doesn’t the mass of the particle matter?

2. Which will have more dissolve particles in a saturated solution? K_{sp}=2 E – 15

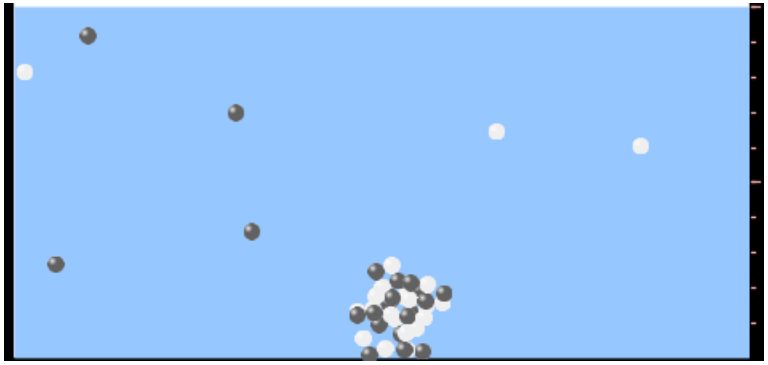
A compound made from

A. X^{+1} and Y^{-1} B. X^{+2} and Y^{-2} C. no difference

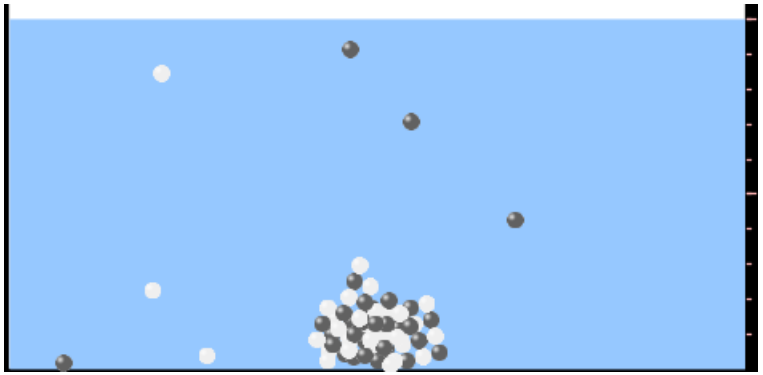




Answer to 2



XY



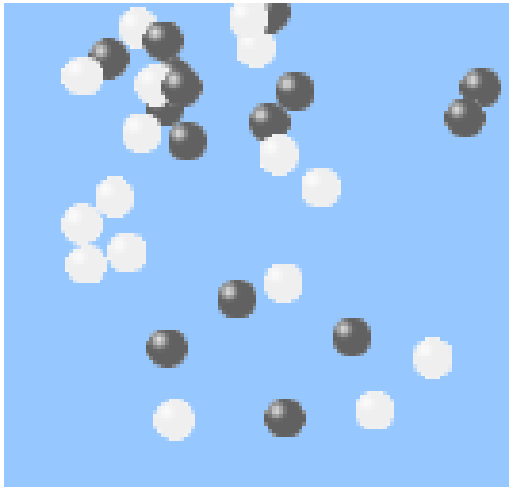
XY

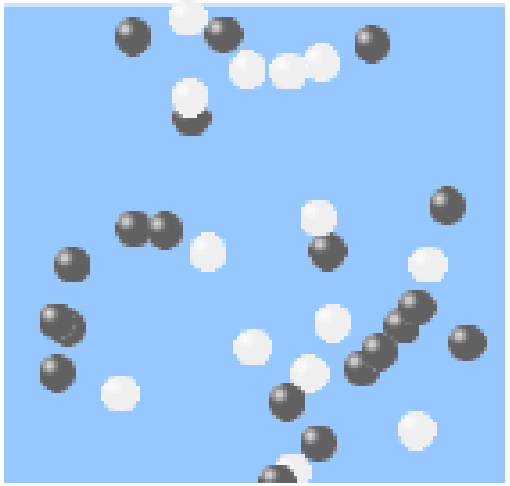
3. Which will have more dissolve particles in a saturated solution?

K_{sp}=2 E –15

A compound made from

A. X^{+2} and Y^{-2} B. X^{+2} and Y^{-3} C. no difference



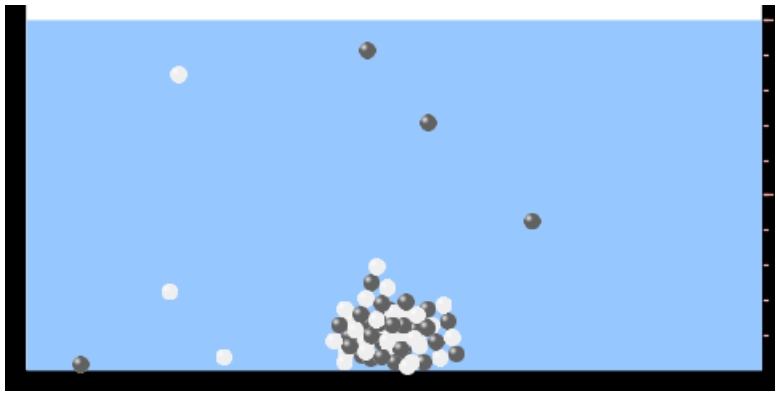


Answer to 3

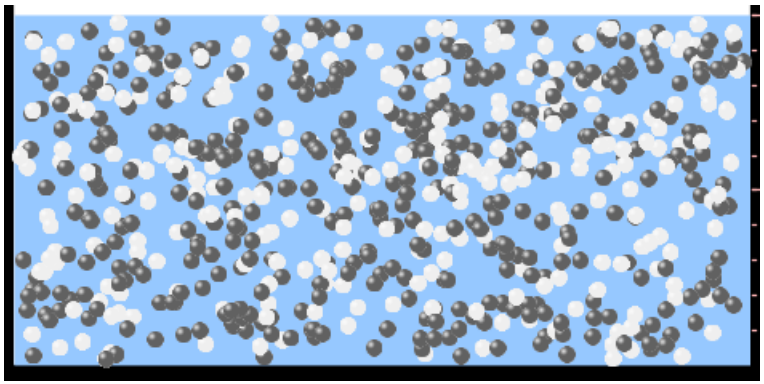
$$A.K_{sp} = x^2; x = 4E-8$$

$$B.K_{sp} = (3x)^3(2x)^2; x = 5E-4$$

If you run the sim at the default volume, you cannot get the second compound to ppt, but only 4 dissolve of the first.



XY



X_3Y_2

Reactions and Rates 1 Clicker Questions

Activity 1: Introduction to reactions

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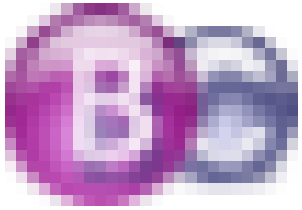
Learning Goals

Students will be able to:

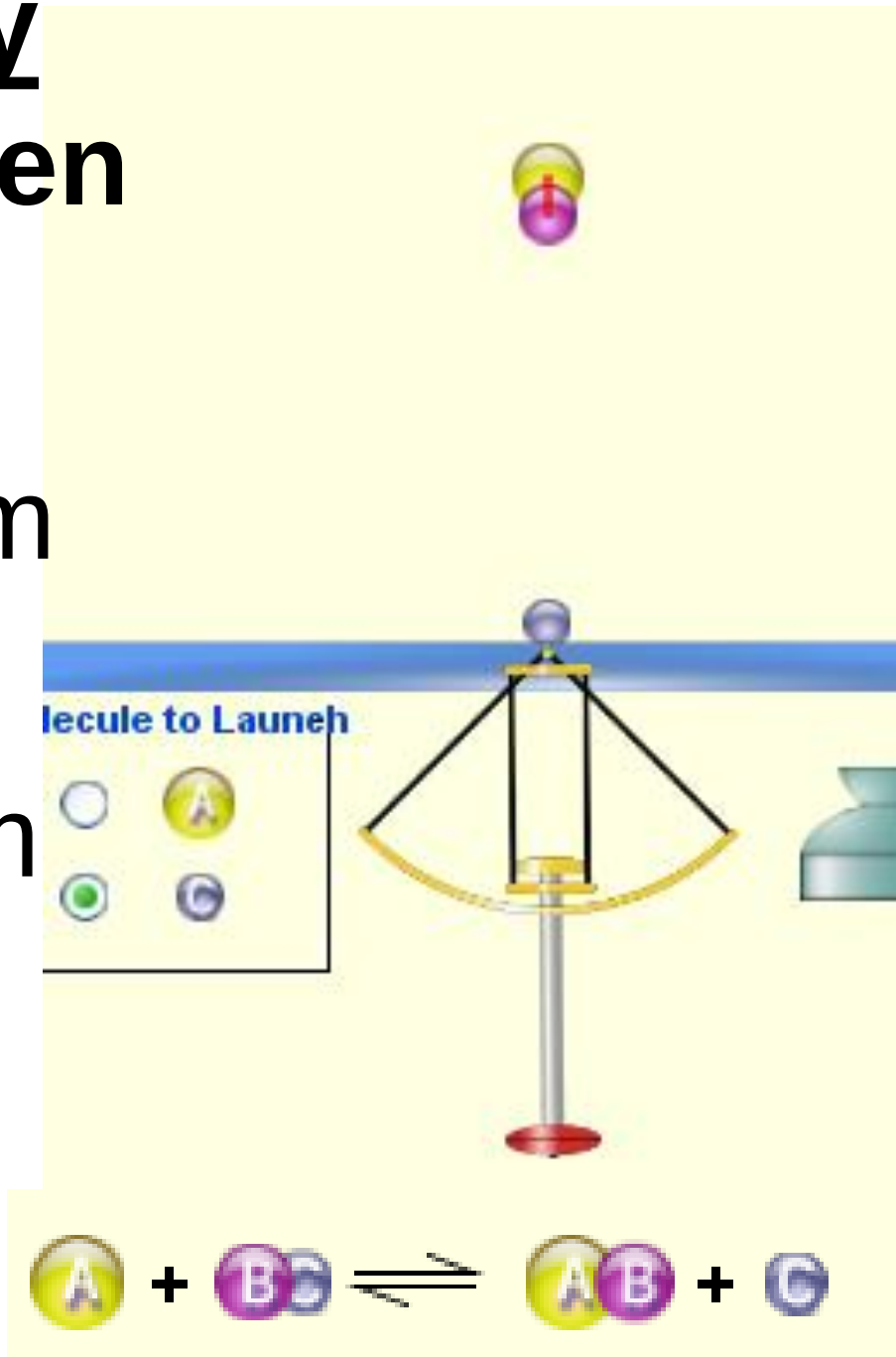
1. Describe reactions in terms of a simple molecular model.
2. Describe reactions in terms of molecular models with illustrations.
3. Differentiate between dissolving and reacting
4. Use the molecular model to explain why reactions are not instantaneous.
5. Use the molecular model to explain why reactions have less than 100% yields.

What will <u>probably</u> immediately happen ?

A  will form

B  will form

C No reaction

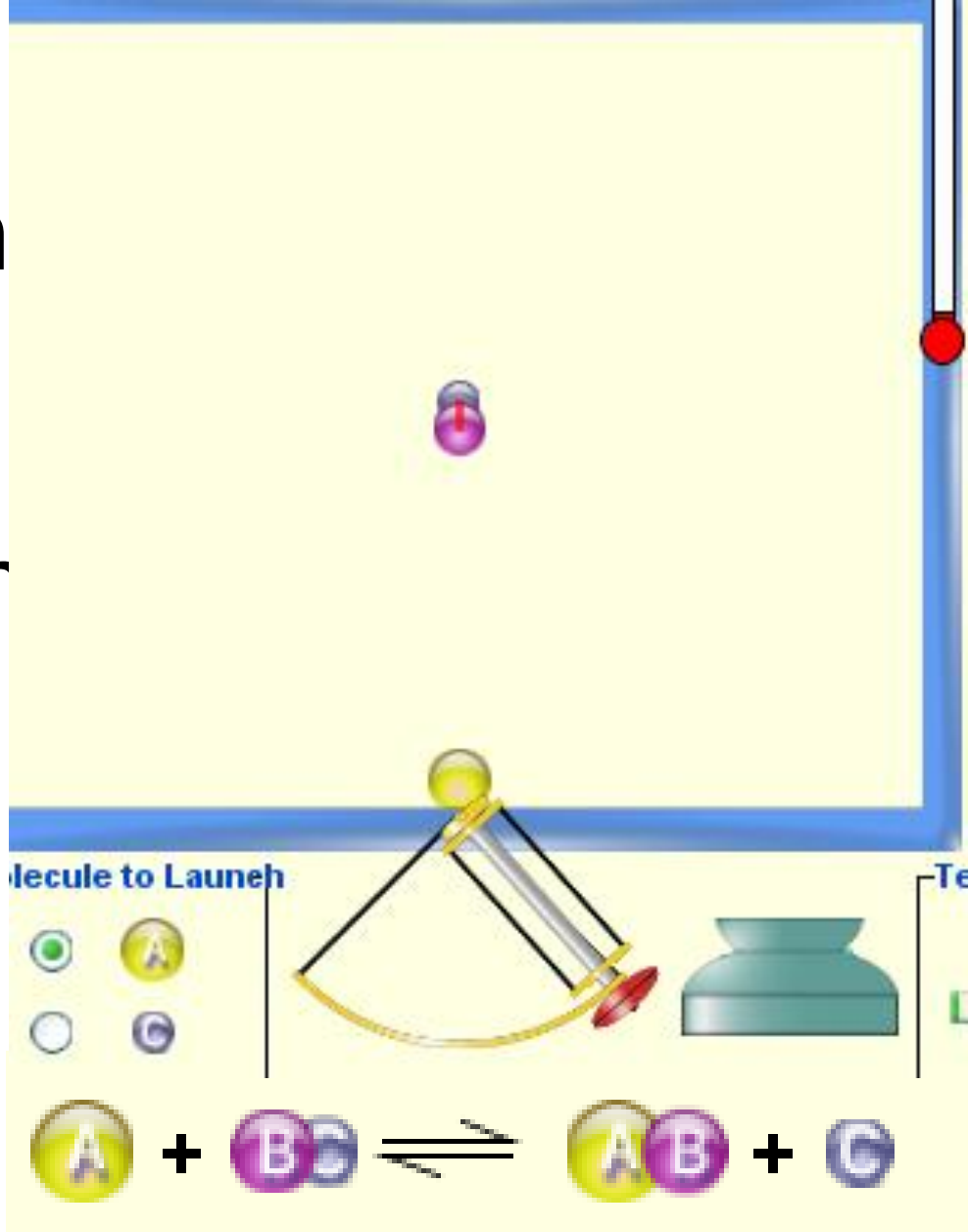


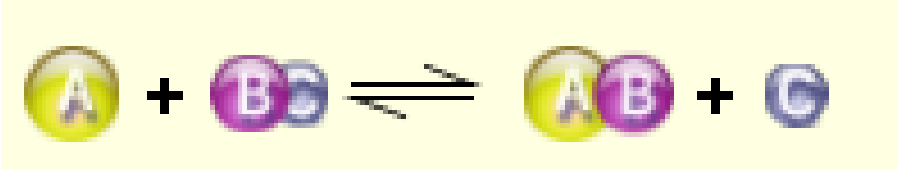
What will <u>probably</u> happen ?

A  will form

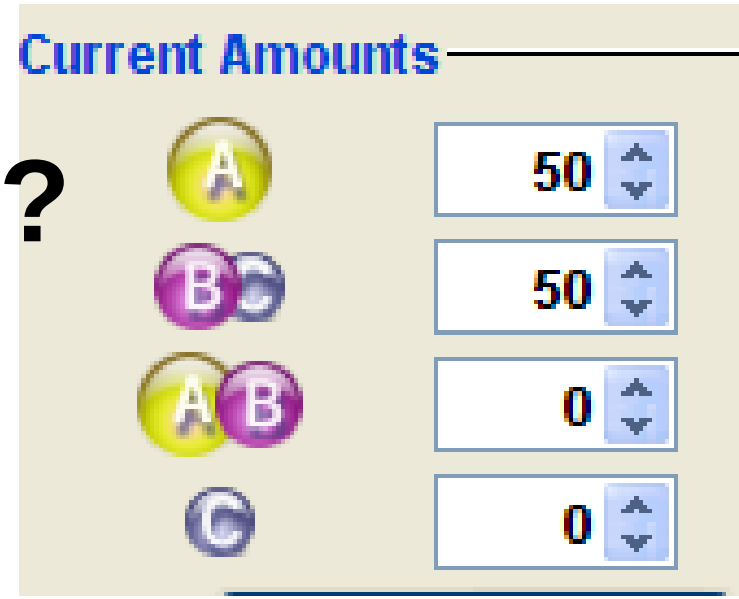
B  will form

C No reaction

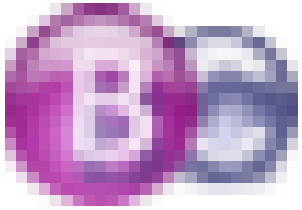




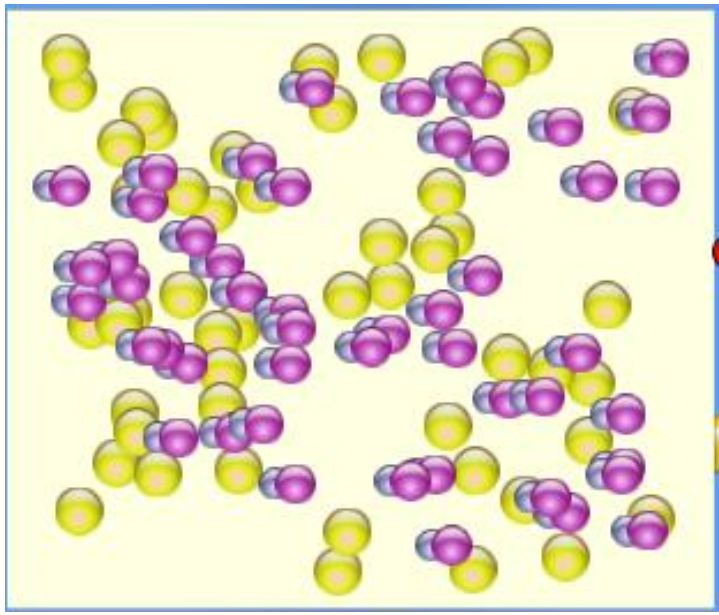
What will <u>probably</u> immediately happen ?

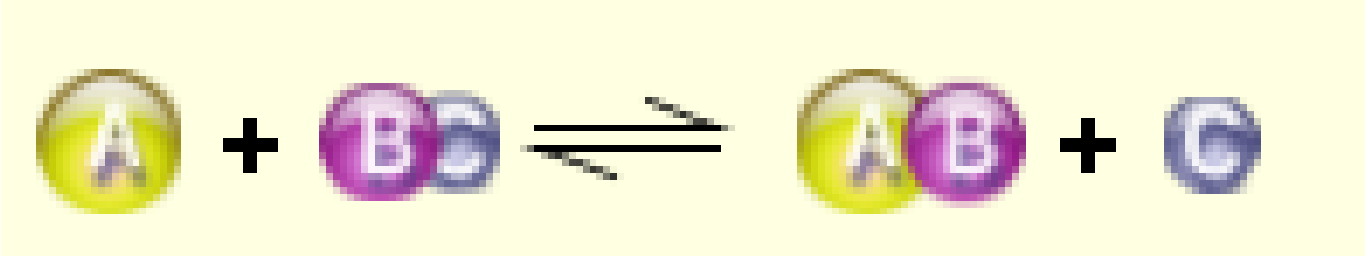


A  will form

B  will form

C No reaction





What will <u>most likely</u> be in the container after several minutes have passed ?

A. Container will have only  & 

B. Container will have only  & 

C. Container will have a mixture of all four

Reactions and Rates 2 Clicker Questions

Activity 2: Introduction to reactions

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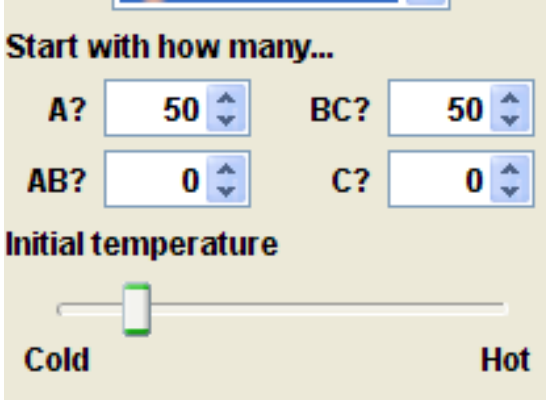
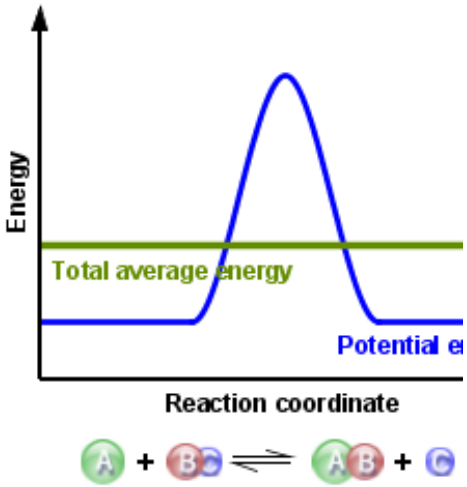
Learning Goals

Students will be able to:

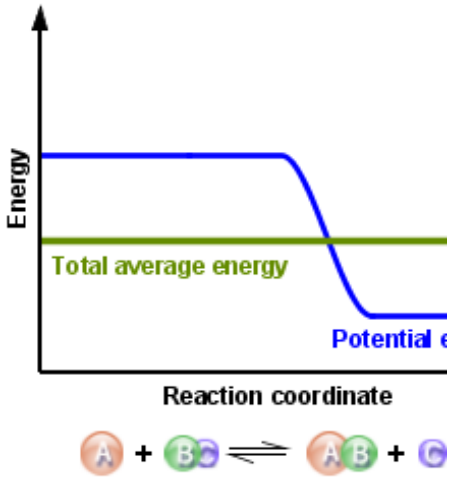
- Describe how the **reaction coordinate** can be used to predict whether a reaction will proceed including how the potential energy of the system changes.
- Describe what affects the potential energy of the particles and how that relates to the energy graph.
- Describe how the reaction coordinate can be used to predict whether a reaction will proceed **slowly, quickly or not at all**.
- Use the potential energy diagram to determine:
  - The *approximate* activation energy for the forward and reverse reactions.
  - The *sign* difference in energy between reactants and products.
- Draw a potential energy diagram from the energies of reactants and products and activation energy.

Which reaction would probably appear to be quickest?

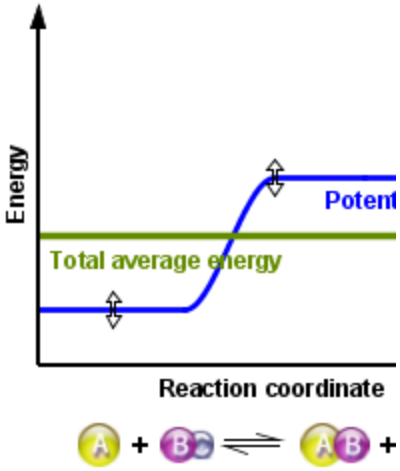




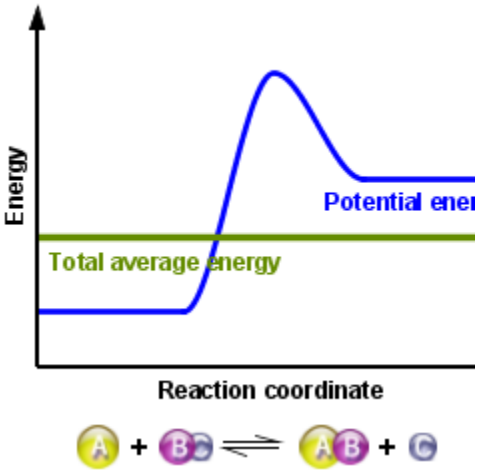
A



B

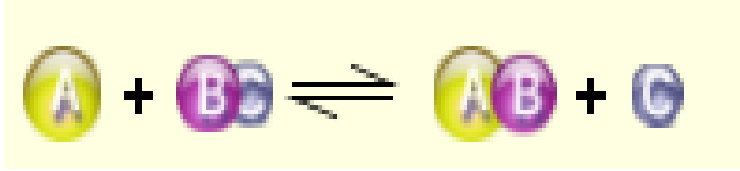


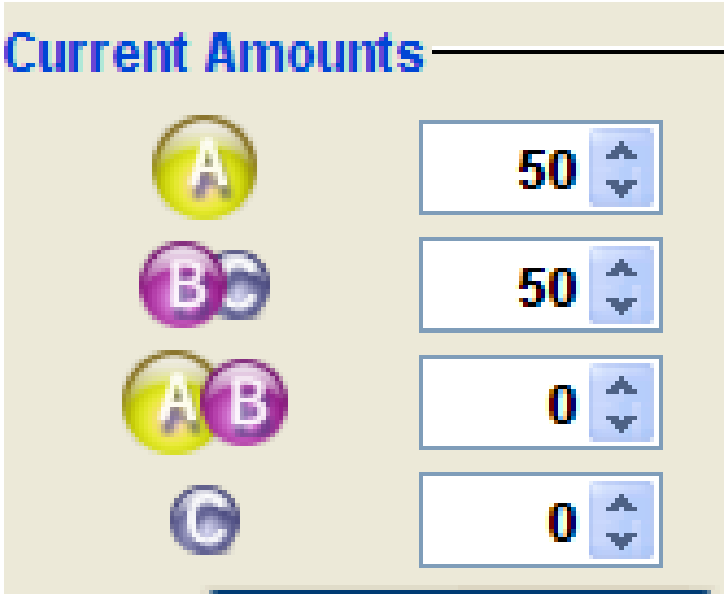
C

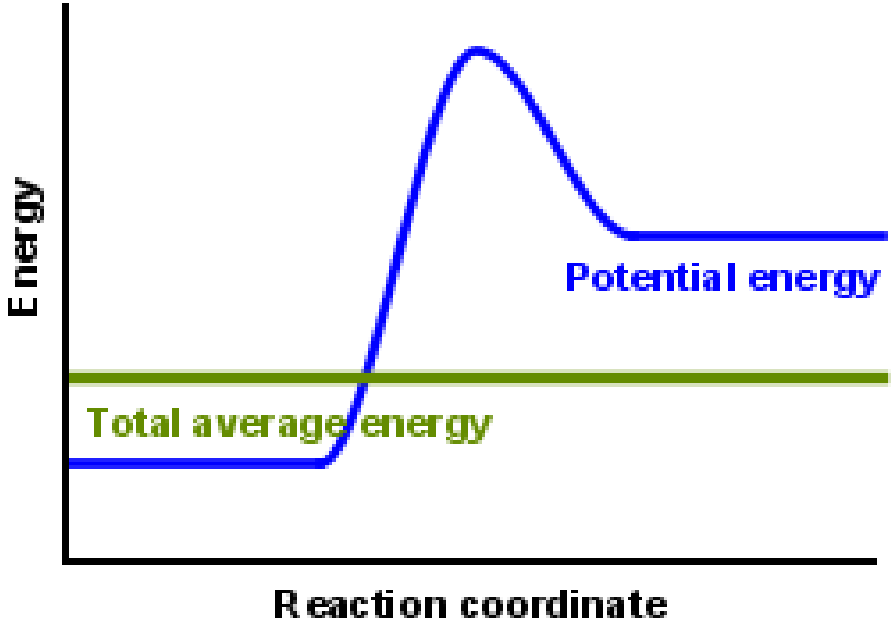


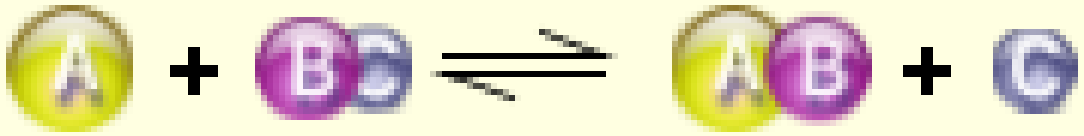
D

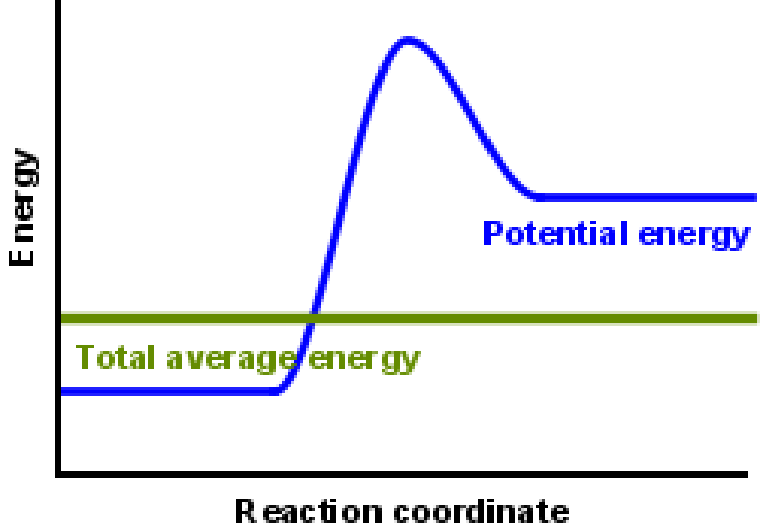
What would best describe what is in the container after several minutes have passed ?











Answer choices

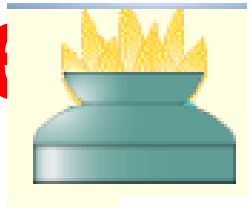
A. Container will have only AB & C

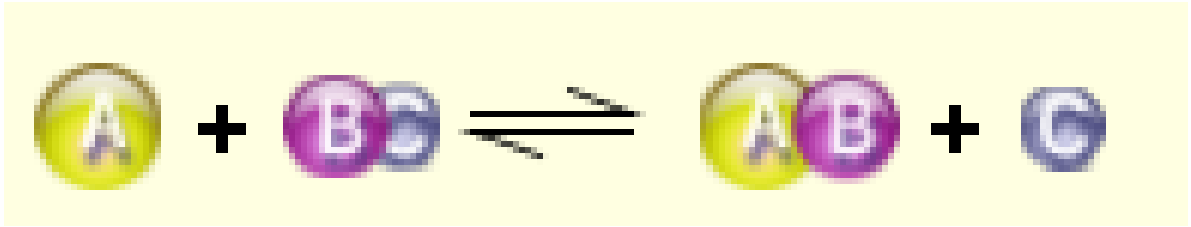
B. Container will have only A & BC

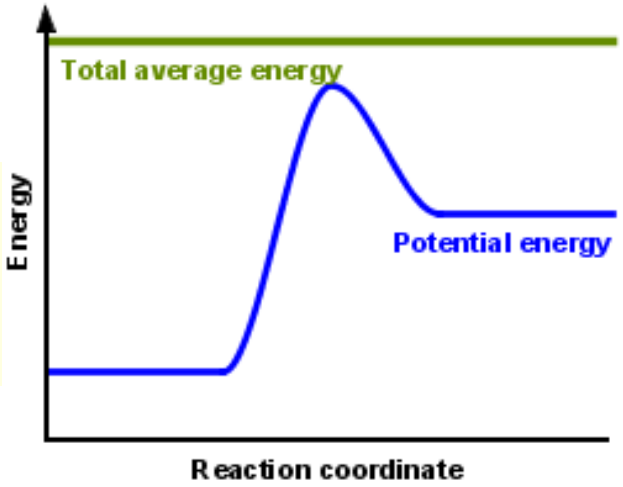
C. Container will have a mixture of all four with more AB & C

D. Container will have a mixture of all four with more A & BC

Using the heate would





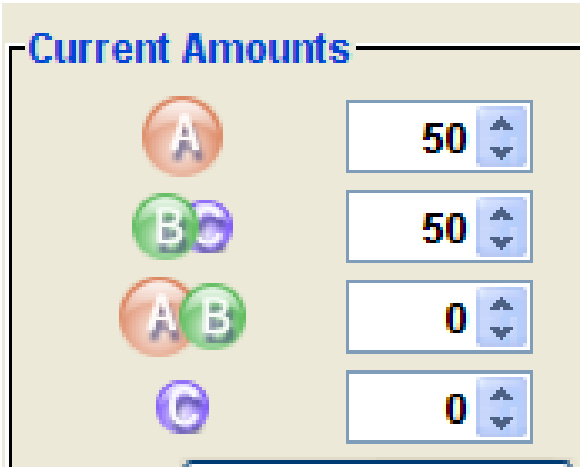


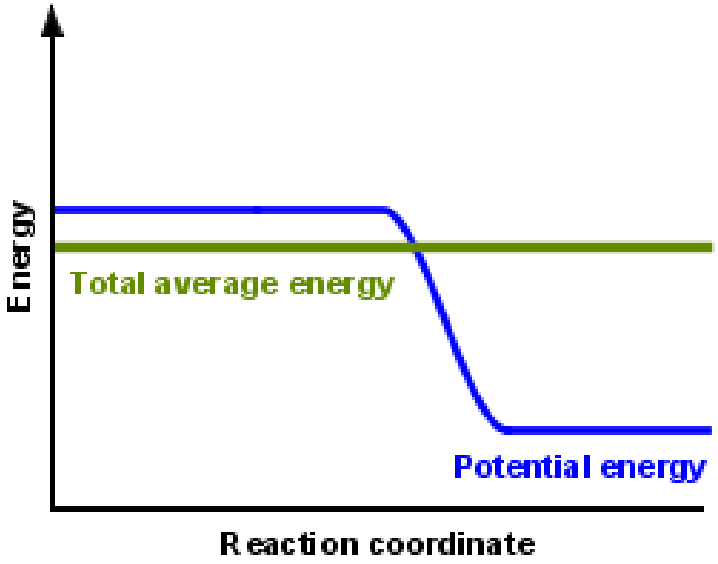
A. Increase the number of  & 

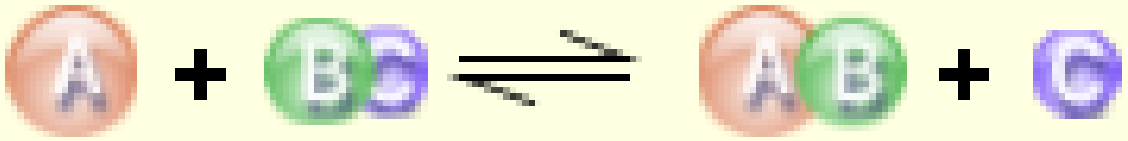
B. Increase the number of  & 

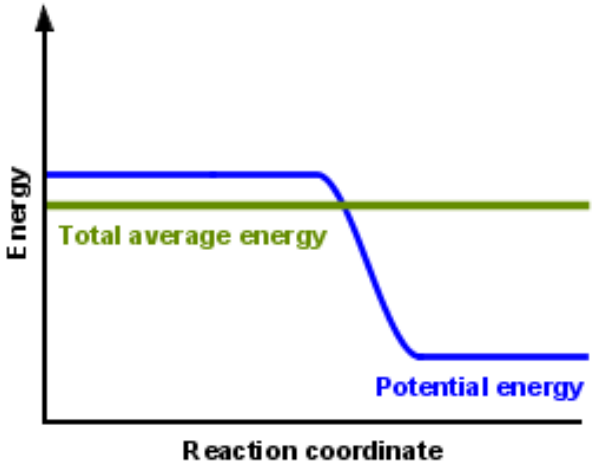
C. Have no effect

What would best describe what is in the container after several minutes have passed ?









Answer choices

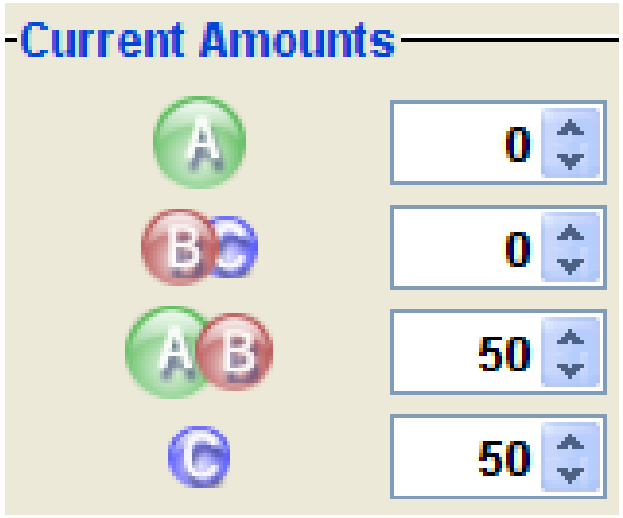
A. Container will have only  & 

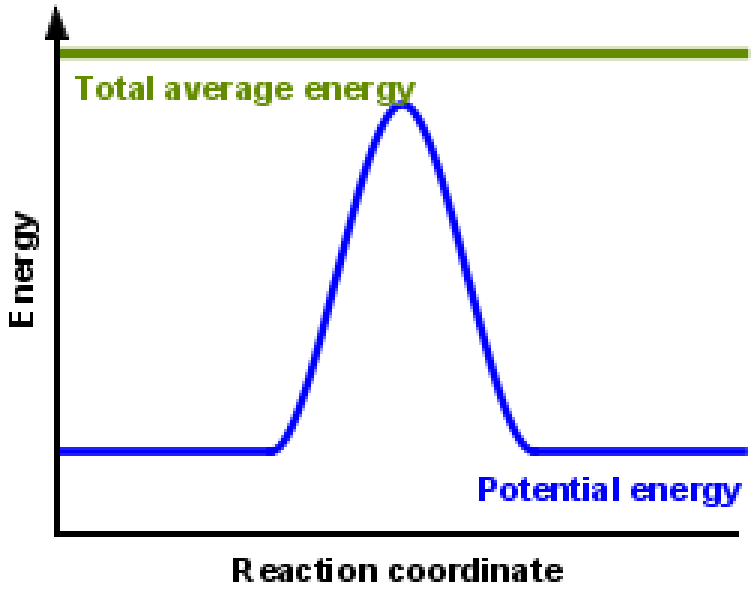
B. Container will have only  & 

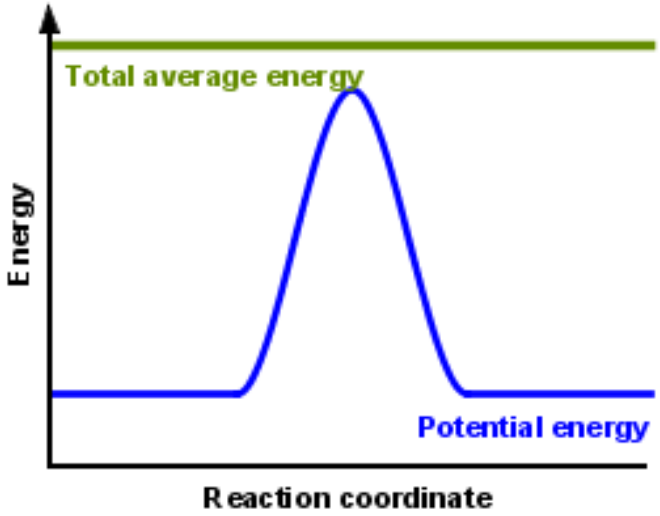
C. Container will have a mixture of all four with more  & 

D. Container will have a mixture of all four with more  & 

What would best describe what is in the container after several minutes have passed ?







Answer choices

A. Container will have mostly  & 

B. Container will have mostly  & 

C. Container will have a mixture of all four with nearly equal amounts

D. No reaction will occur since the products and reactants have the same energy

Reactions and Rates 3 Clicker Questions

Activity 3:
Introduction to **Equilibrium**

Trish Loeblein
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Learning Goals

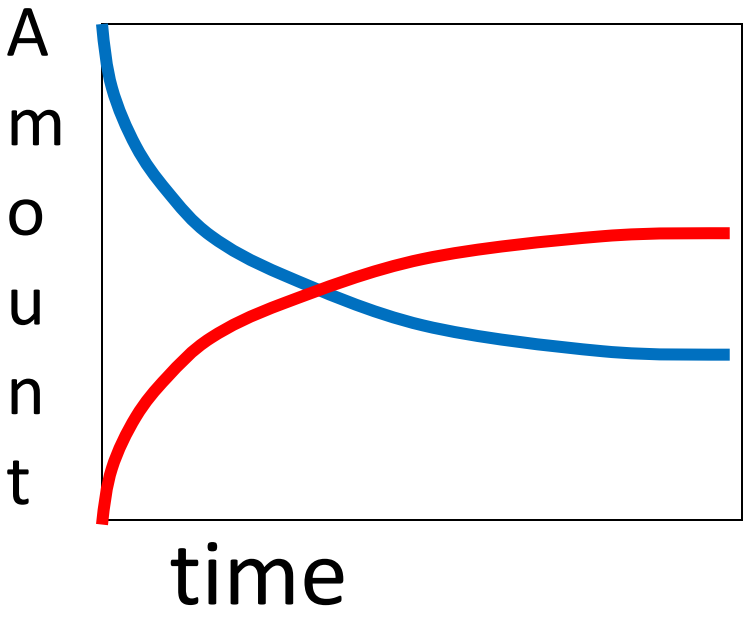
Students will be able to:

- Use a physical experiment to model chemical equilibrium
- Sketch how the number of reactants and products will change as a reaction proceeds
- Predict how changing the initial conditions will affect the equilibrium amounts of reactants and products.
- Predict how the shape of the reaction coordinate will affect the equilibrium amounts of reactants and products.

Which best shows that equilibrium has been reached?

A

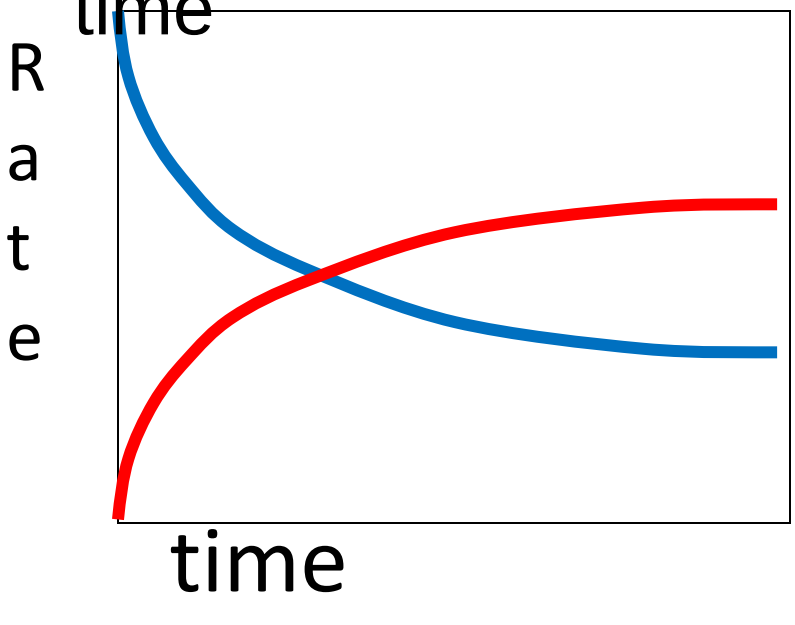
Amount of substance vs time



-Product **-Reactants**

B

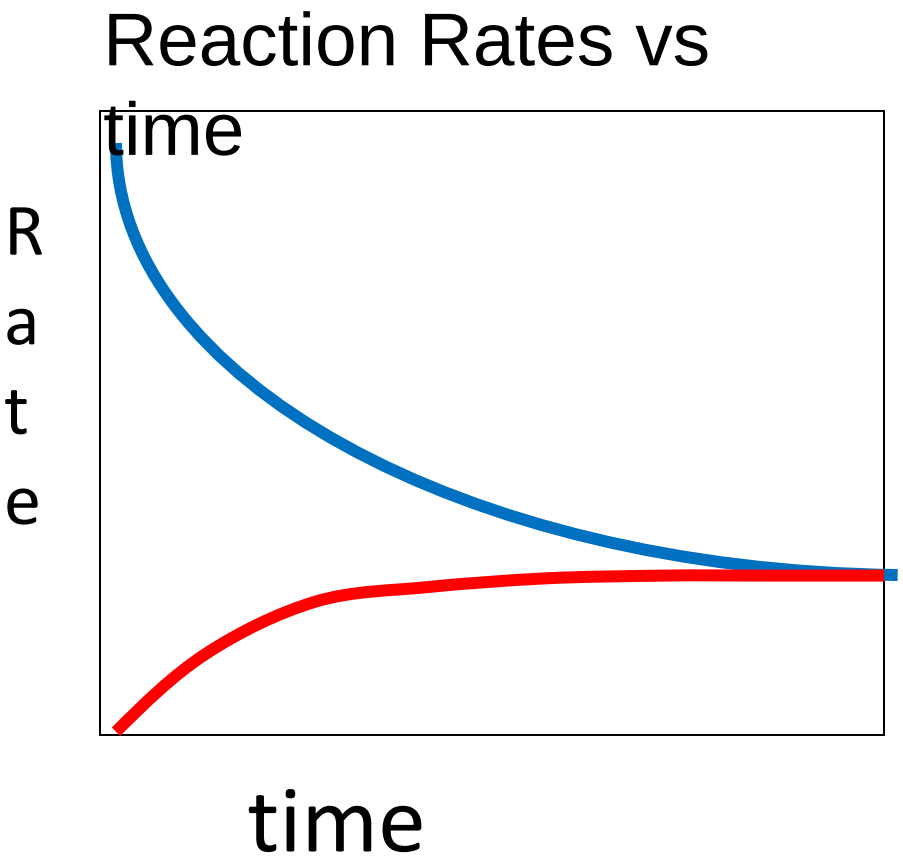
Reaction Rates vs time



-Forward **-Reverse**

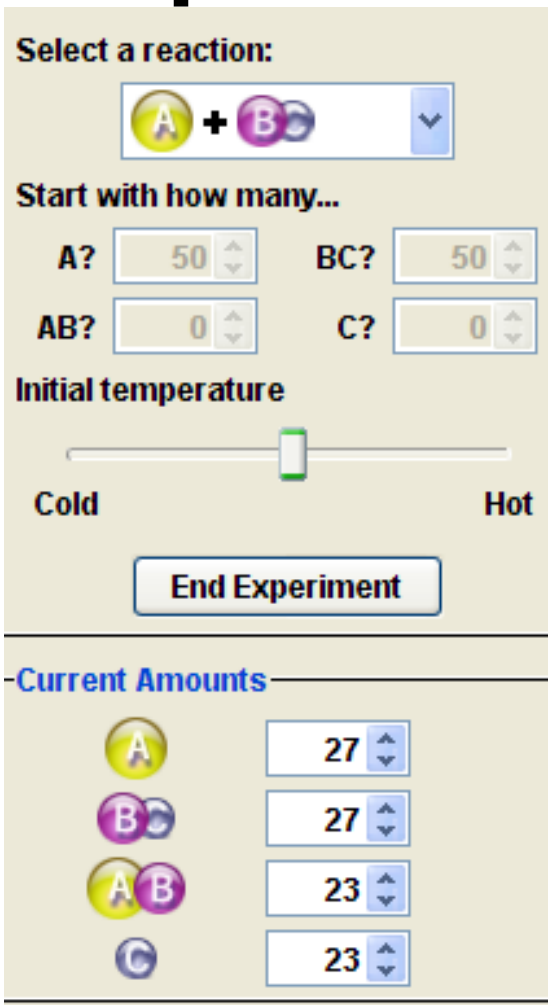
Correct rate graph

Forward reaction rate =Reverse rate

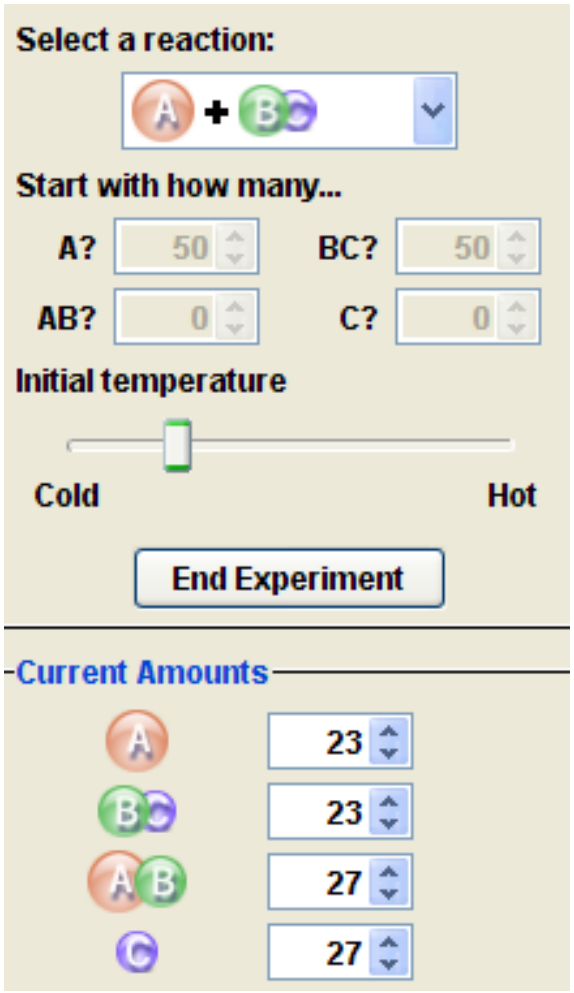


-Forward **-Reverse**

Which could show that equilibrium has been reached?



A

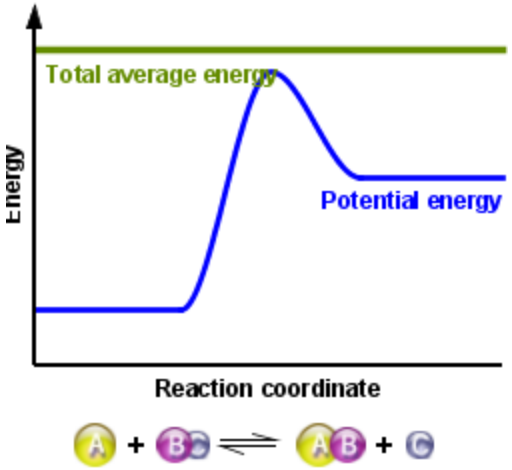


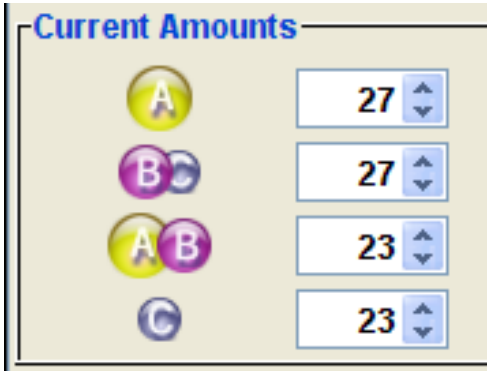
B

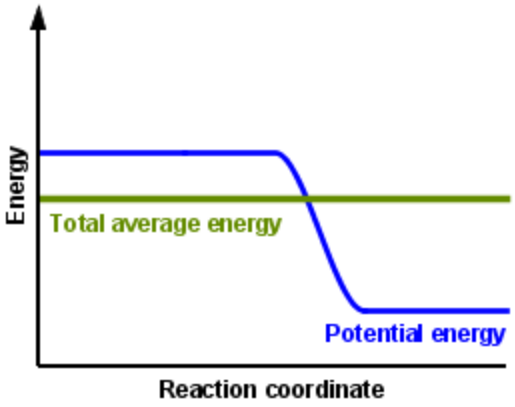
C neither

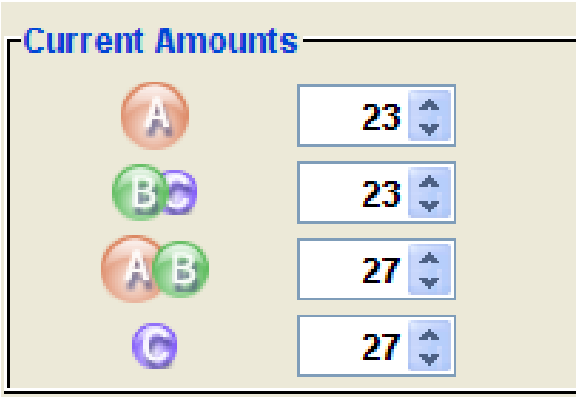
D either

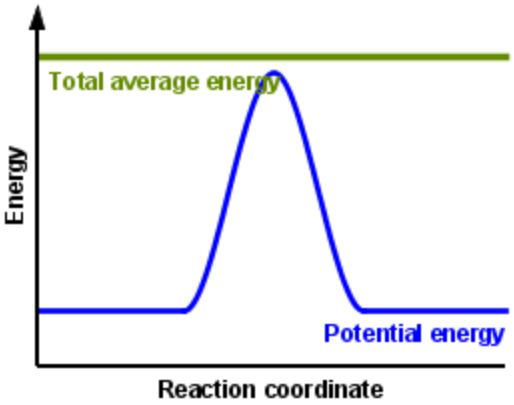
All are at equilibrium within limits

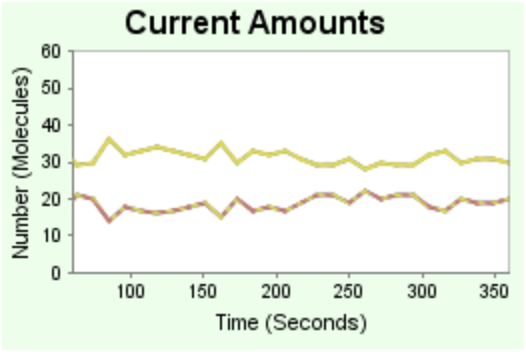


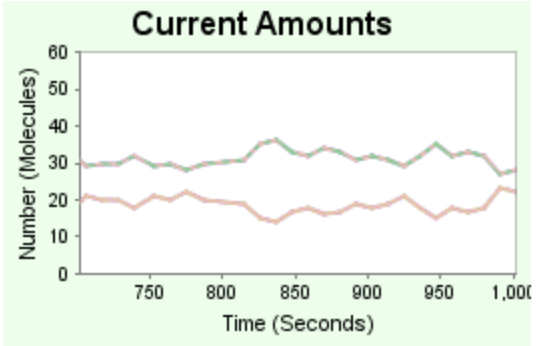


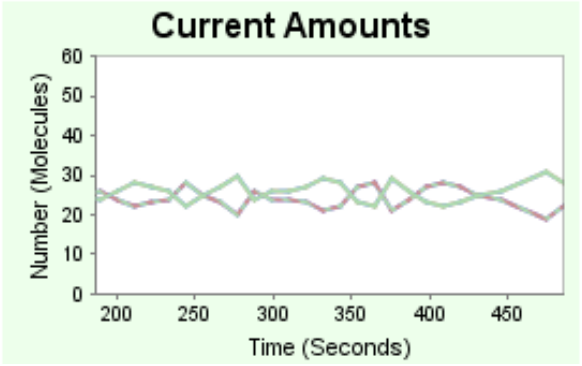












Which best shows that equilibrium has been reached?

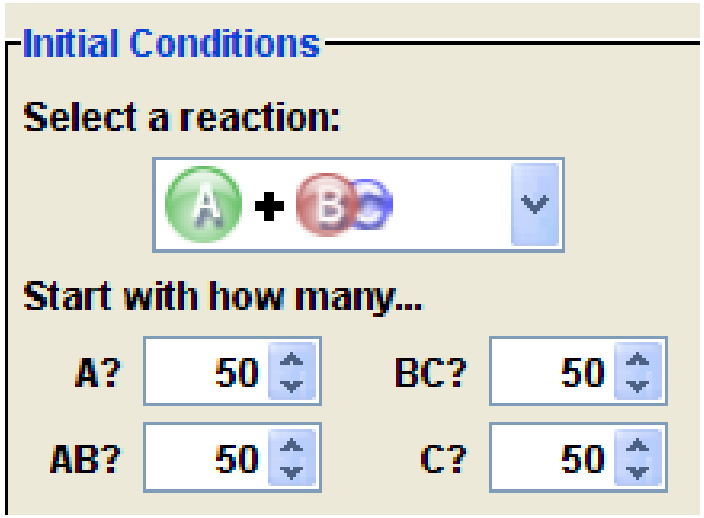
A. The number of reactants is greater than the products

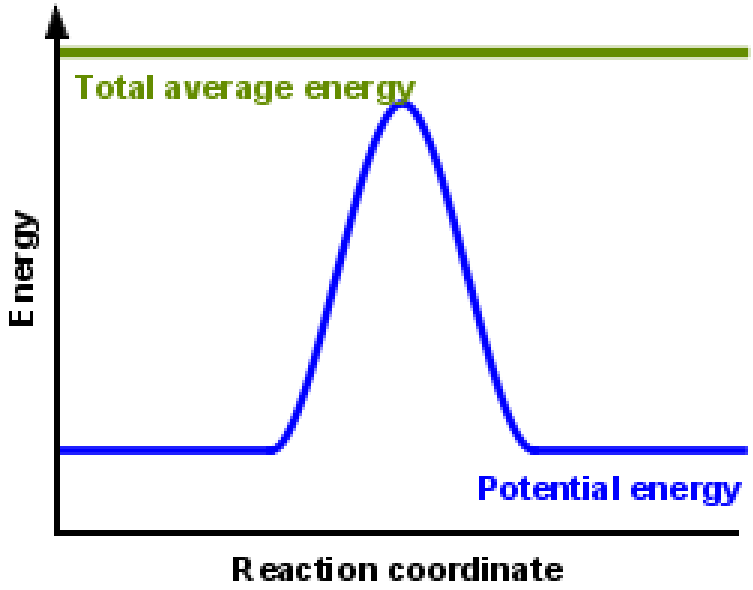
B. The number of products is greater than the reactants

C. The number of products is equal to the reactants

D. The number of products varies little

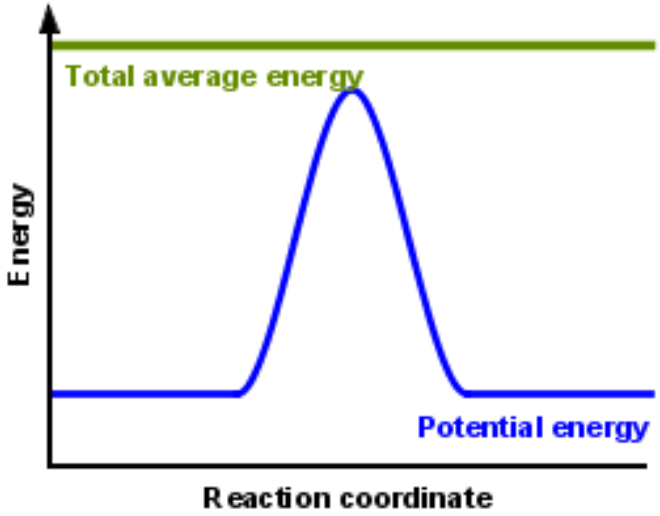
At equilibrium, what would you predict is in the container?





Start with how many...

A?	50	BC?	50
AB?	50	C?	50

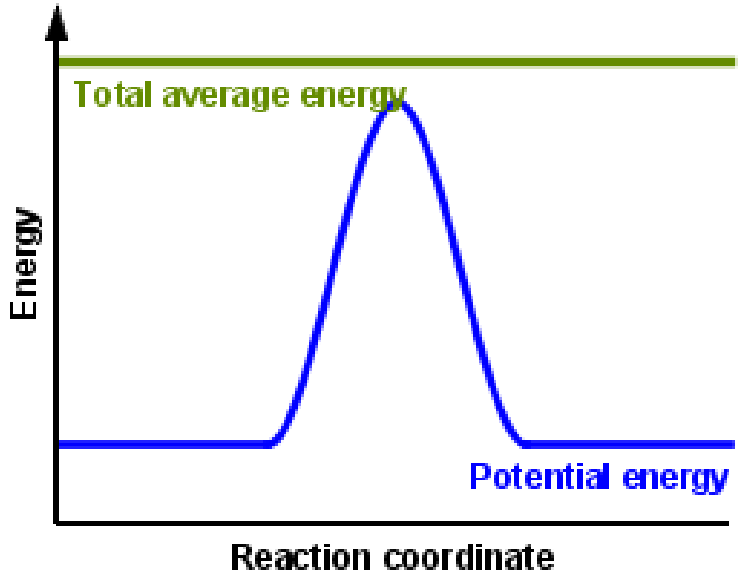


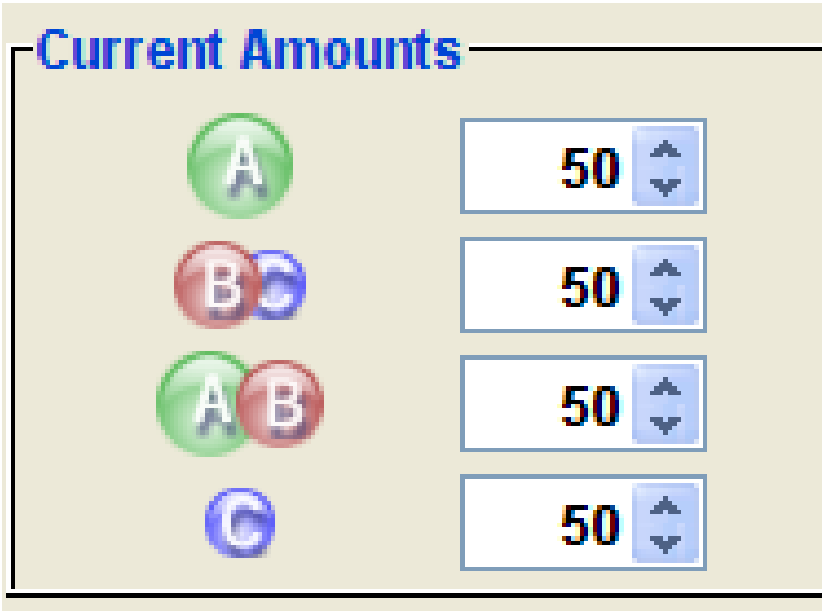
A. Container will have mostly  & 

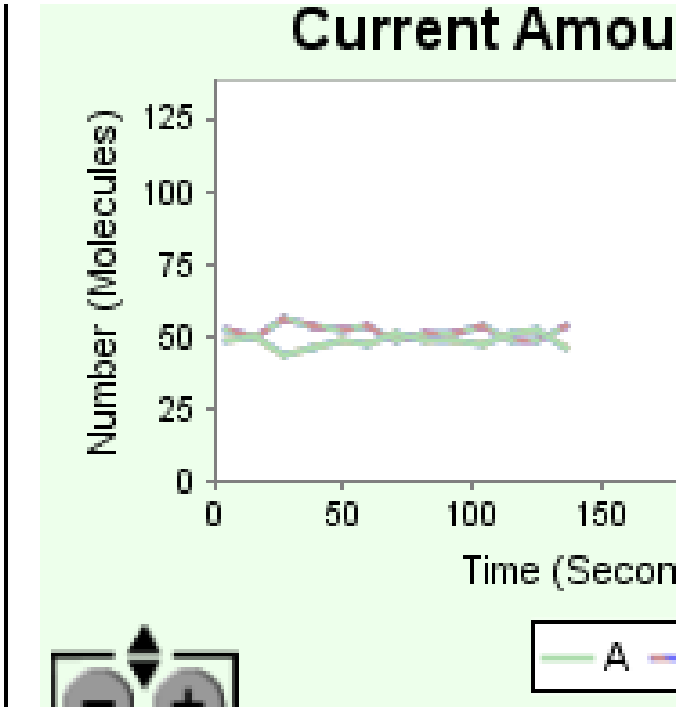
B. Container will have mostly  & 

C. Container will have a mixture of all four with nearly equal amounts

D. No reaction will occur since the products and reactants have the same energy

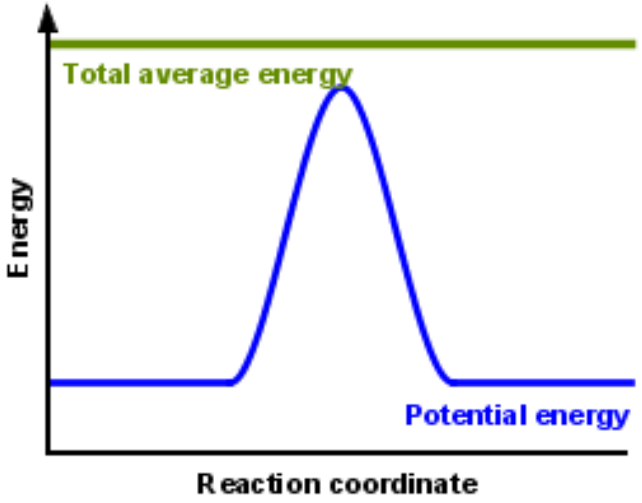

Total average energy
Energy
Potential energy
Reaction coordinate


Current Amounts
A
50
BC
50
AB
50
C
50


Current Amou
Number (Molecules)
125
100
75
50
25
0
0
50
100
150
Time (Secon
A

data

How will the equilibrium of second trial compare to the equilibrium of the first?



First experiment

Initial Conditions

Select a reaction:

A + BC

Start with how many...

A?	50	BC?	50
AB?	50	C?	50

Second experiment

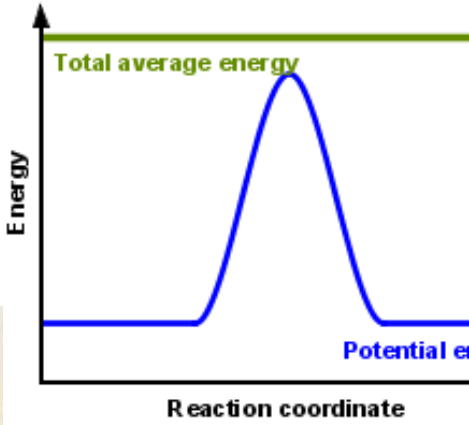
Initial Conditions

Select a reaction:

A + BC

Start with how many...

A?	100	BC?	50
AB?	50	C?	50



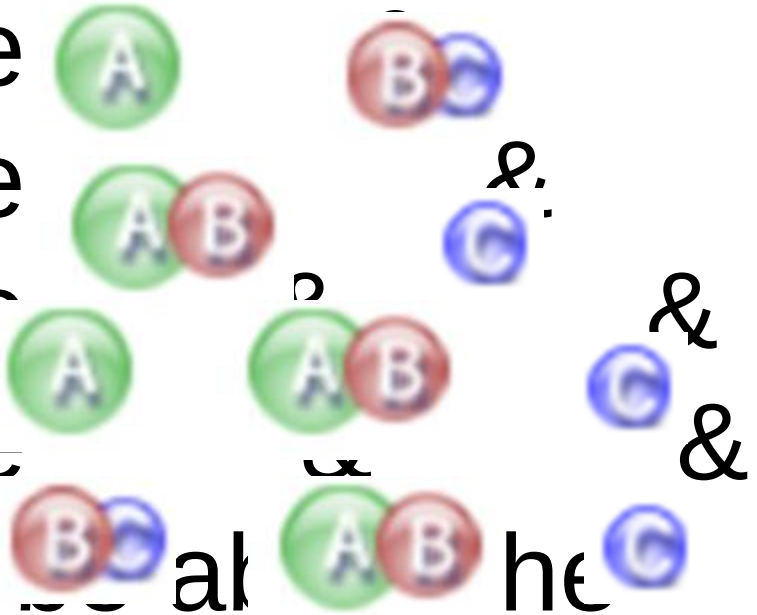
First trial

A?	50	BC?	50
AB?	50	C?	50

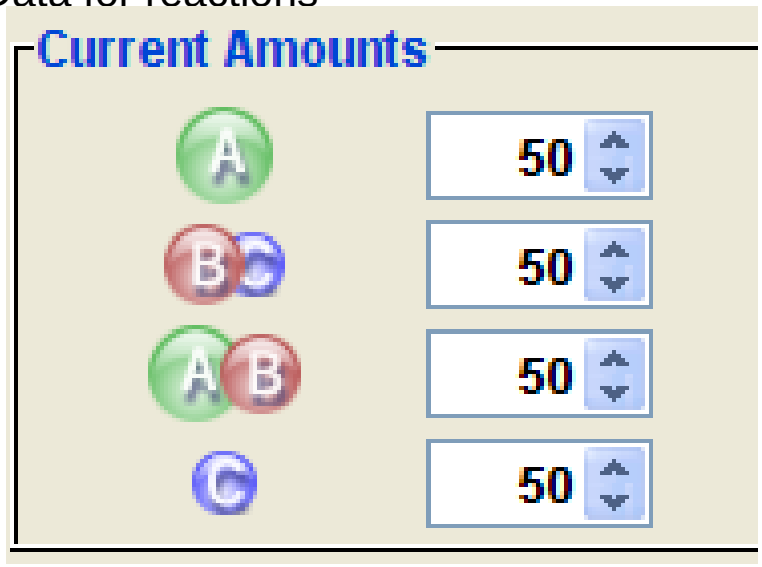
Second trial

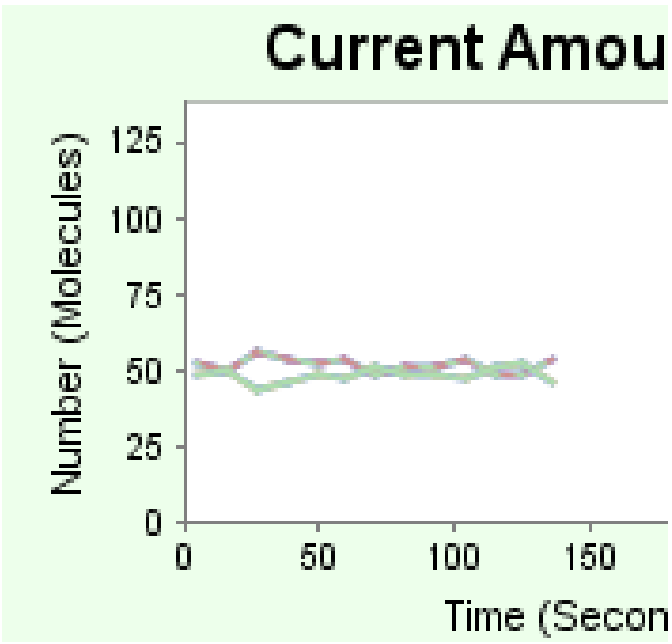
A?	100	BC?	50
AB?	50	C?	50

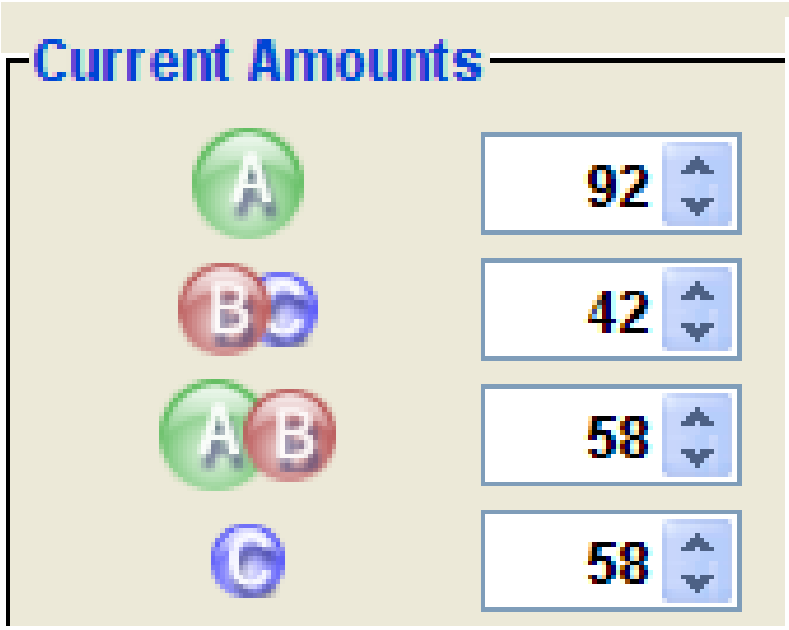
A. There will be more
B. There will be more
C. There will be more
D. There will be more
E. The ratios will still be about the same

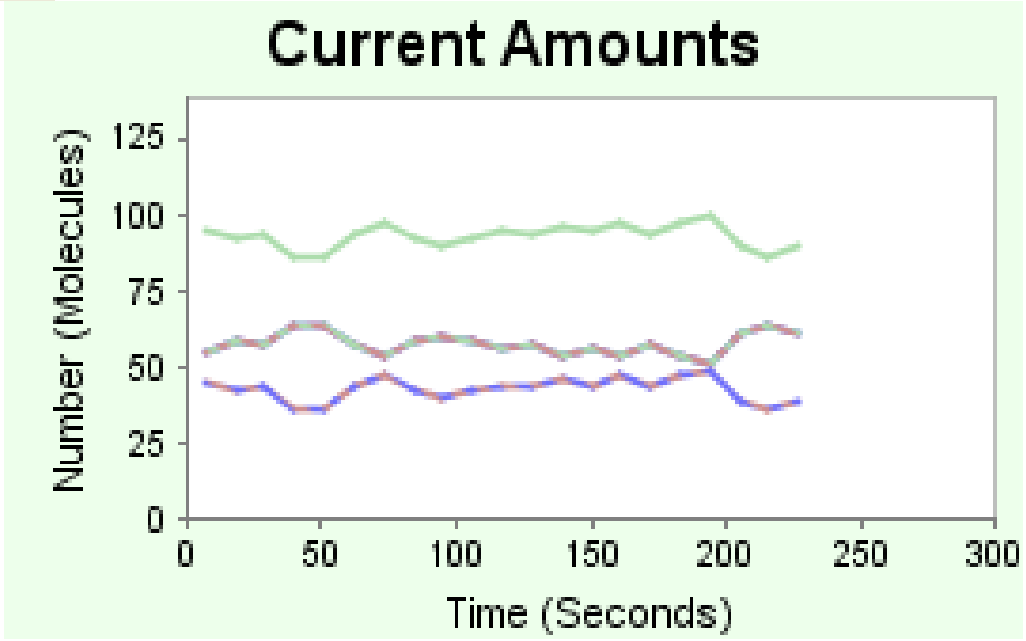


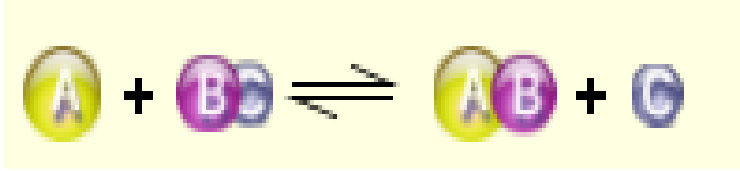
Data for reactions



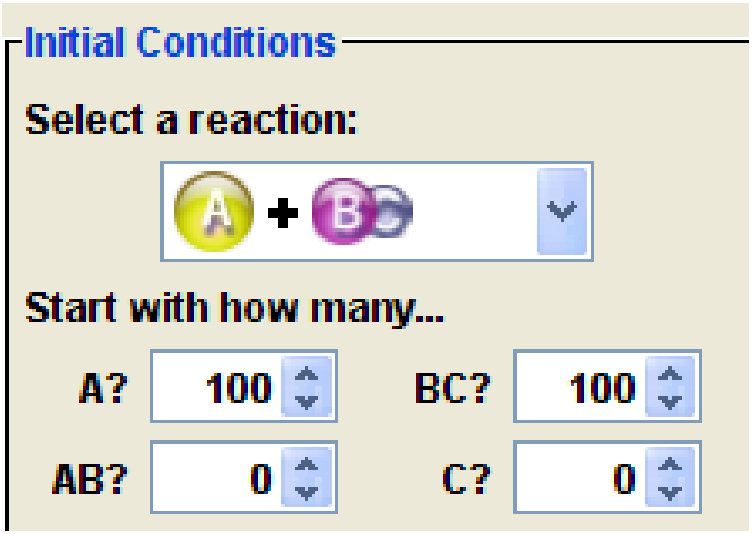


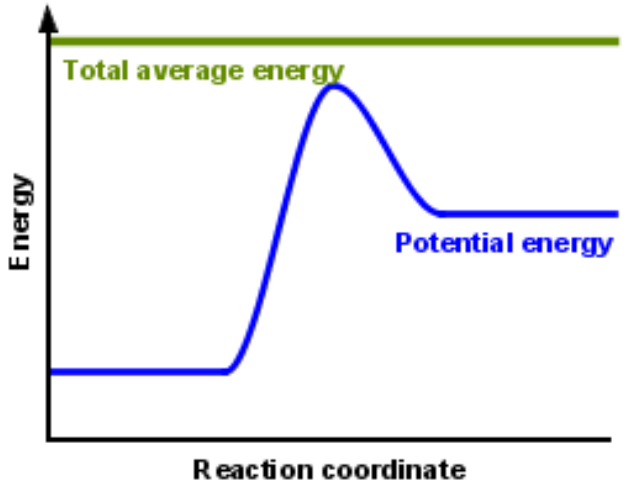


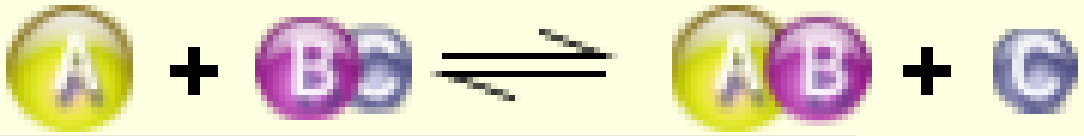




At equilibrium, what would you predict is in the container?

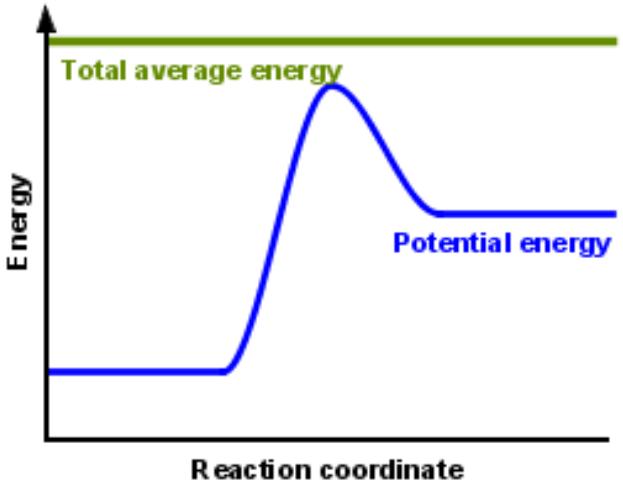






Start with how many...

A?	100	BC?	100
AB?	0	C?	0



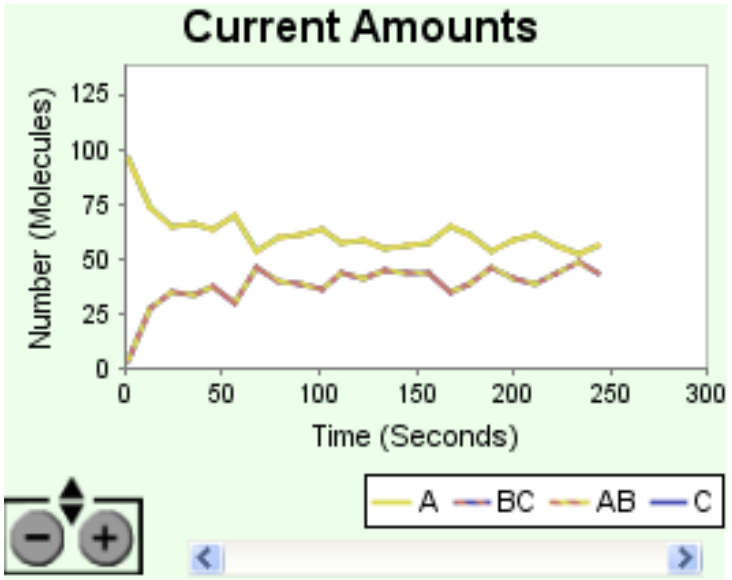
A. Container will have only AB & C

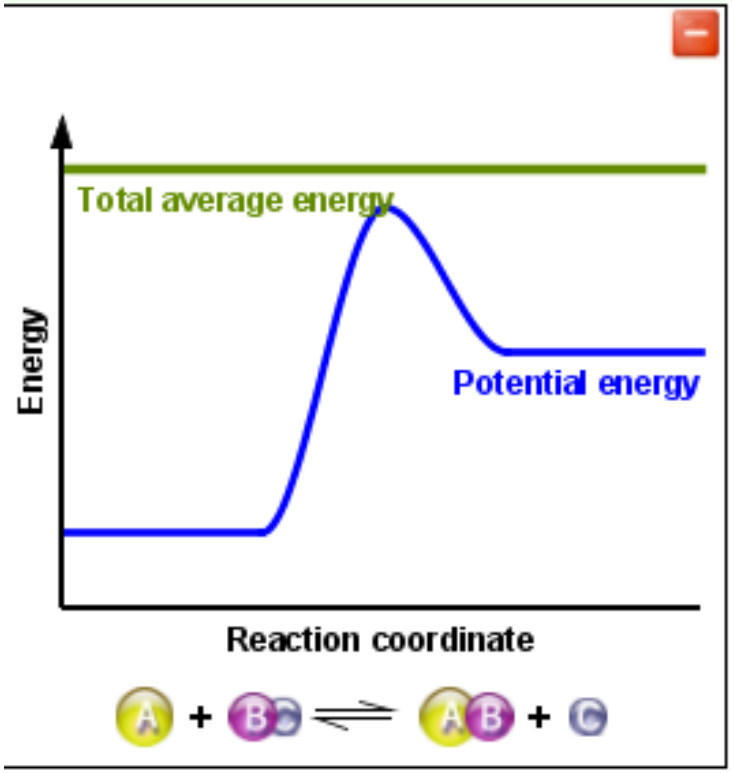
B. Container will have only A & BC

C. Container will have a mixture of all four with more AB & C

D. Container will have a mixture of all four with more A & BC

data





Initial Conditions

Select a reaction:

Start with how many...

A? 100 BC? 100

AB? 0 C? 0

Initial temperature

Cold Hot

End Experiment

Current Amounts

A 54

BC 54

AB 46

C 46

Options

Chart Options

Bar Strip

Pie None

Reactions and Rates 4
Also uses ***Salts & Solubility*** and ***States of Matter***

Clicker Questions

LeChatlier's Principle

Trish Loeblein

PhET/Evergreen High School

http://jeffcoweb.jeffco.k12.co.us/high/evergreen/science/loeblein/chem_syl/syllabus_c.html

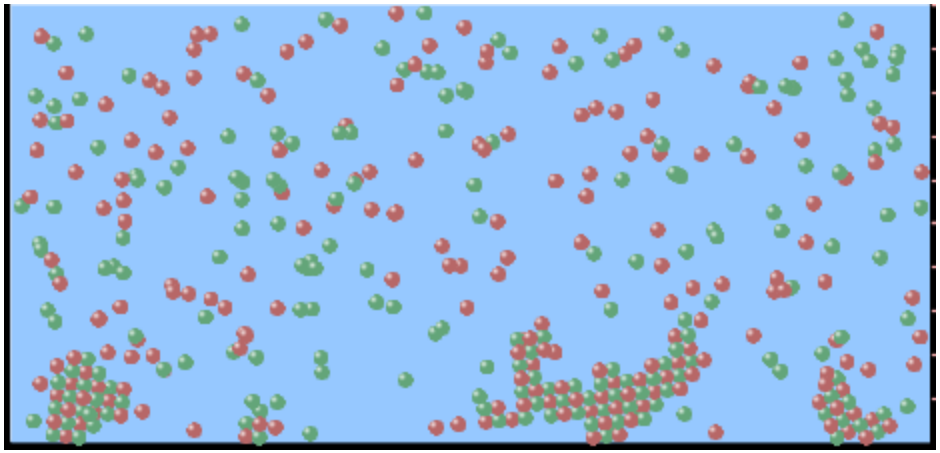
Learning Goals

Students will be able to:

- Explain how to make equilibrium systems change and predict what changes will happen.
- Compare and contrast salt-solution, phase, and chemical equilibriums.

If you add water to this salt solution, what will happen?

$$NaCl(s) \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)}$$



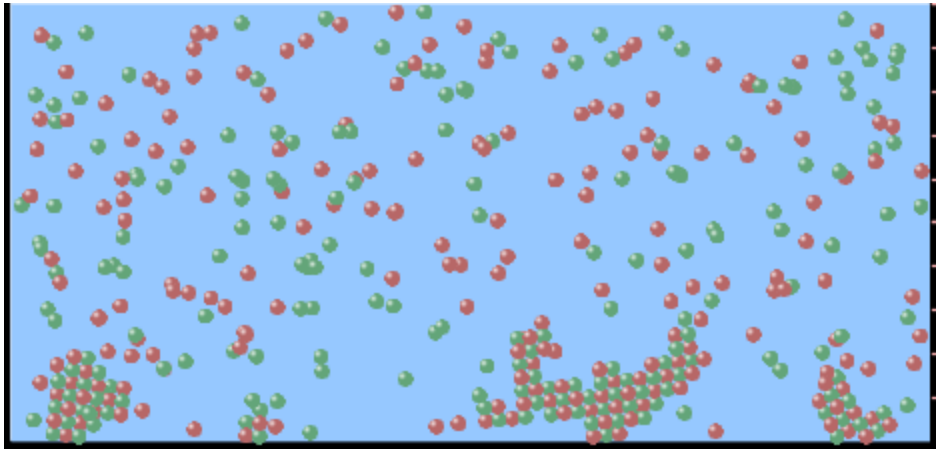
A. The system will shift to the right

B. The system will shift to the left

C. LeChatlier's principle doesn't apply to physical systems

If you increased the air pressure above this salt solution, what will happen?

$$NaCl(s) \rightleftharpoons Na^{+}_{(aq)} + Cl^{-}_{(aq)}$$

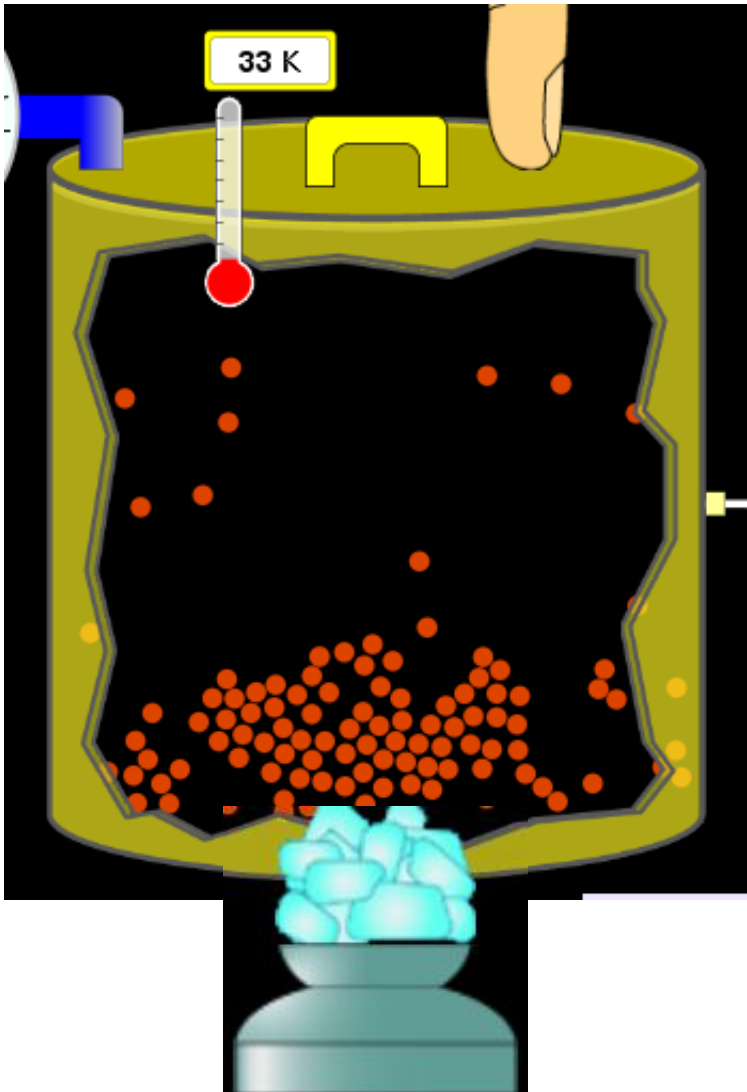


A. The system will shift to the right

B. The system will shift to the left

C. This system would not be effected by pressure changes.

If you cooled the container, what will happen? $Ne_{(l)} \rightleftharpoons Ne_{(g)}$



A. The system will shift to the right

B. The system will shift to the left

C. This system is not effected by temperature

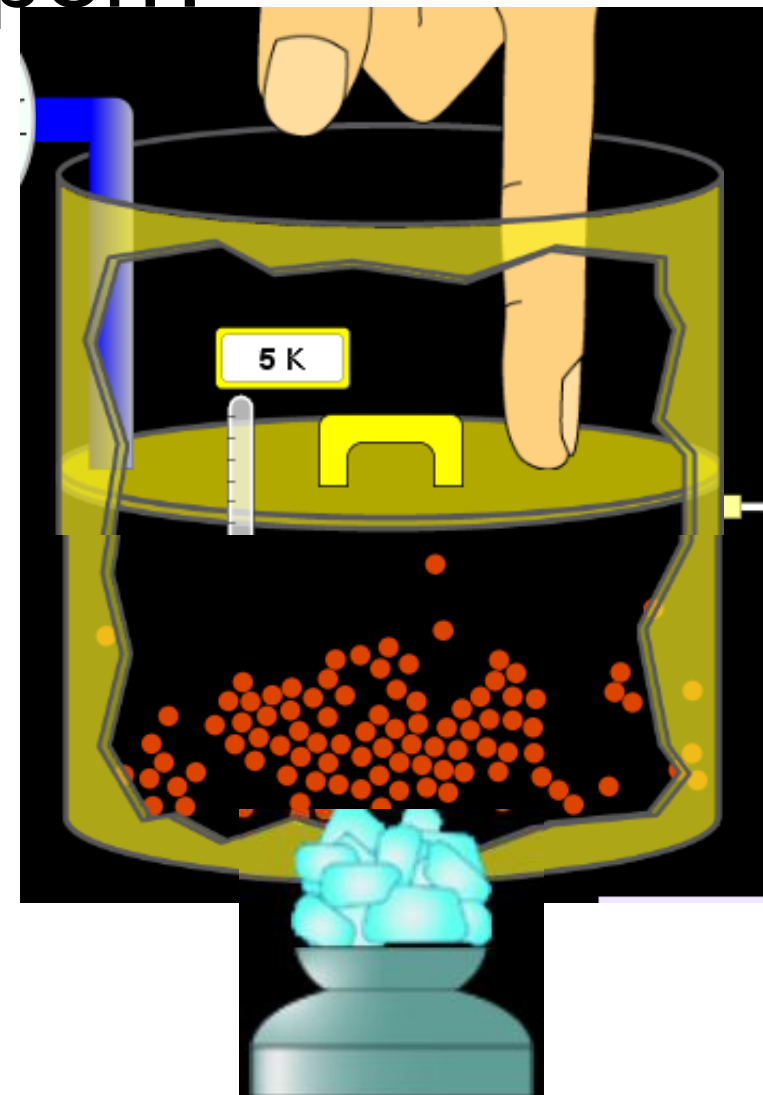
If you made the container smaller, while keeping the temperature constant, what will happen?

$$Ne_{(l)} \rightleftharpoons Ne_{(g)}$$

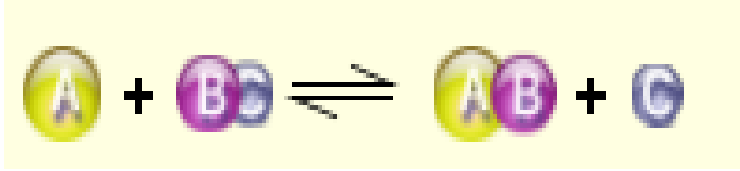
A. The system will shift to the right

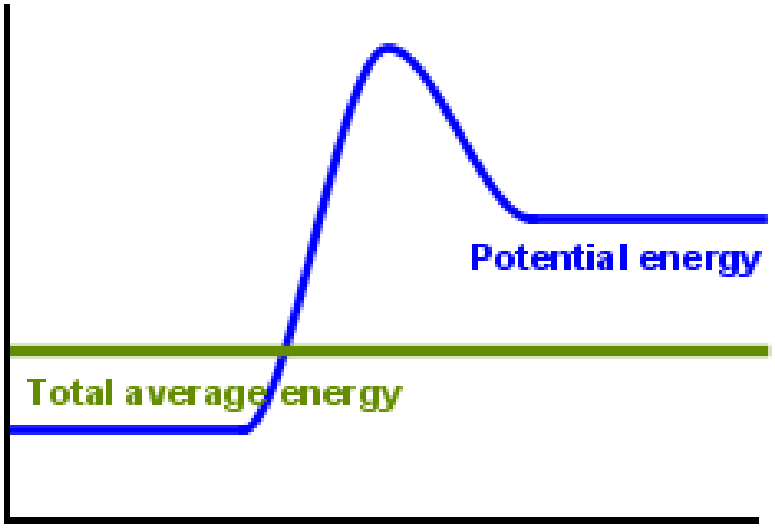
B. The system will shift to the left

C. This system would not effected



What would happen if you added energy using the heater ?

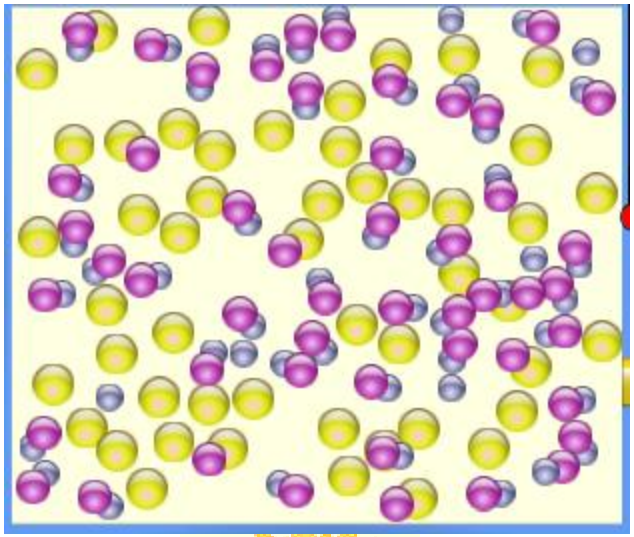


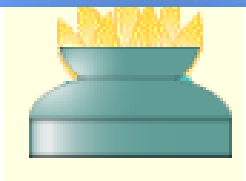


A. The system will shift to the right

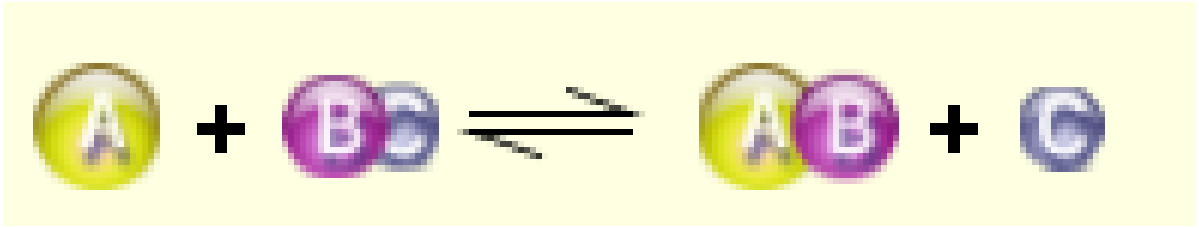
B. The system will shift to the left

C. Both reactants and products would have more energy, but the amounts would not change much





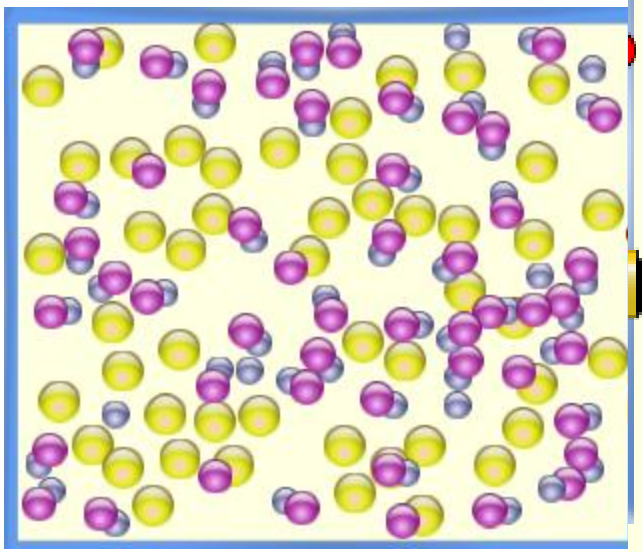
What would happen if you added AB?

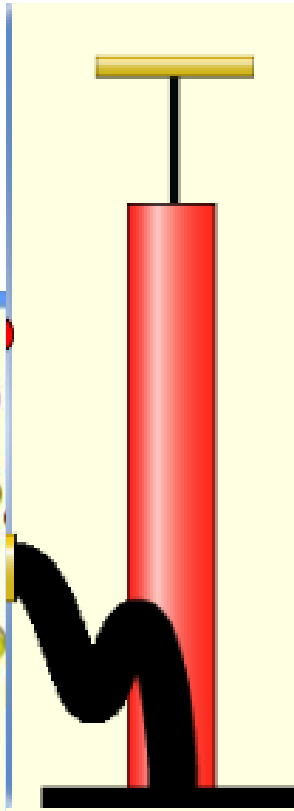


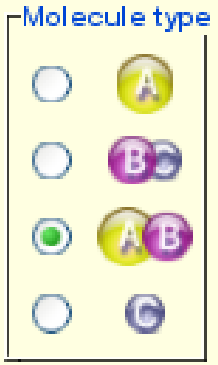
A. The system will shift to the right

B. The system will shift to the left

C. The only change would be the amount o AB





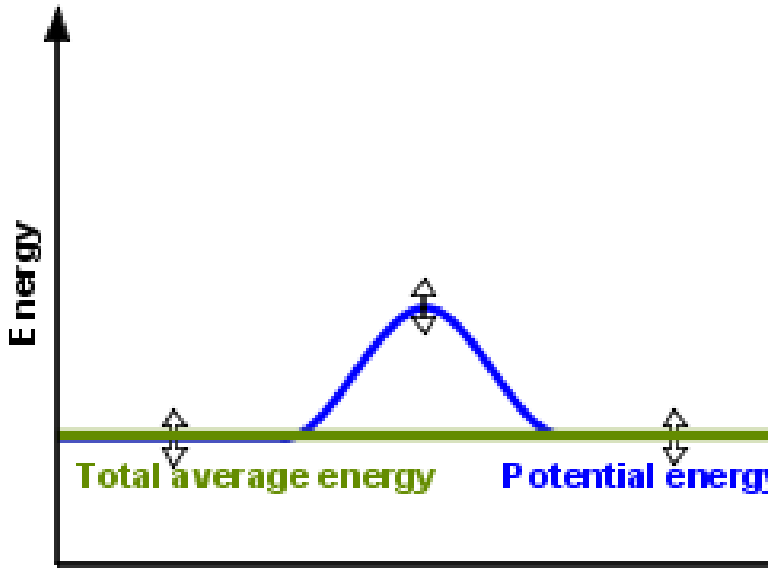


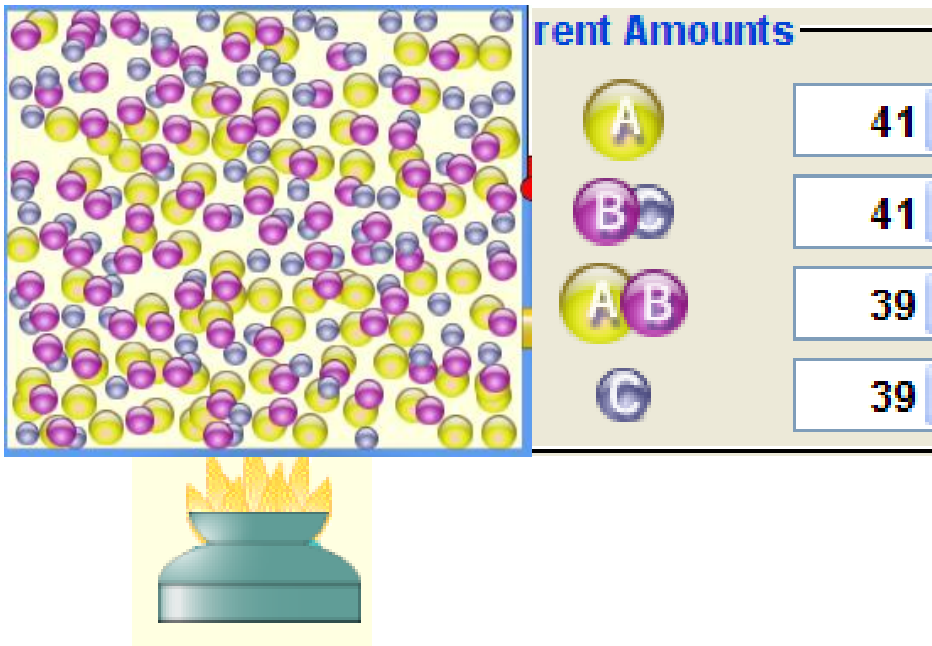
What would happen if you added energy using the heater ?

A. The system will shift to the right

B. The system will shift to the left

C. Both reactants and products would have more energy, but the amounts would not change much





Balancing Chemical Equations Discussion and Clicker questions

by Trish Loeblein

6/12/2011

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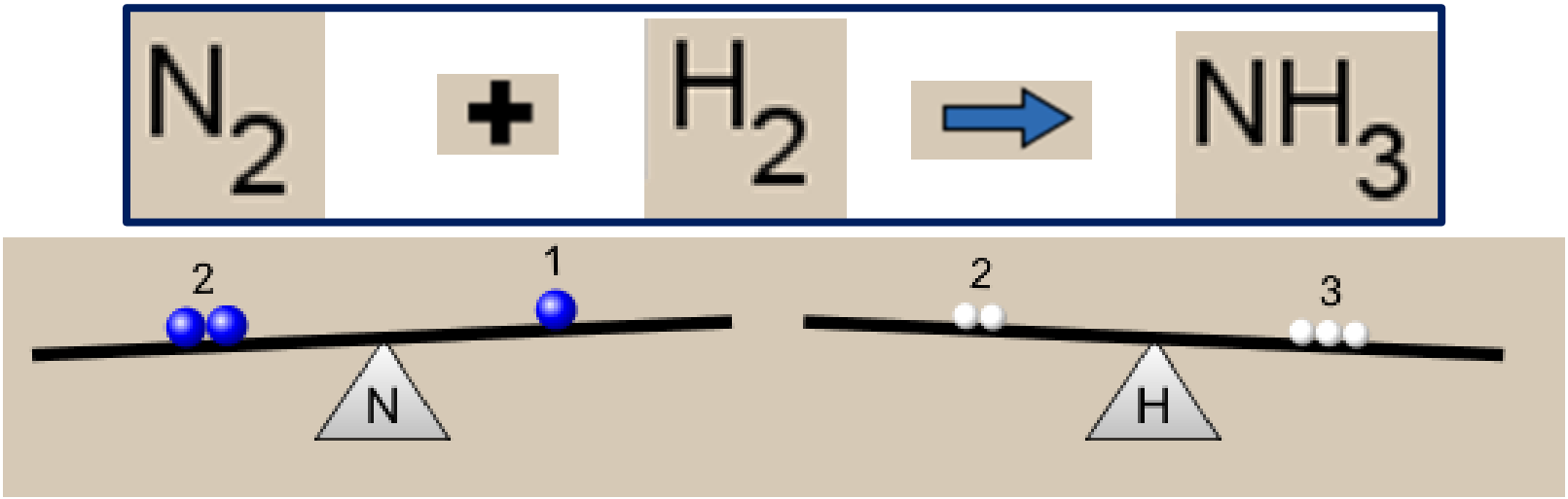
Learning Goals: Students will be able to:

- **Describe what "reactants" and "products" in a chemical equation mean.**
- **Explain the importance of knowing the difference between "coefficients" and "subscripts".**
- **Use pictures and calculations to show how the number of atoms for each product or reactant is found.**
- **Identify the relationship between "reactants" and "products" atoms.**
- **Balance a chemical equation using the relationships identified.**
- **Given a chemical equation, draw molecular representations of the reaction and explain how the representations were derived.**
- **Given a molecular drawing of a chemical reaction, write the equation and explain how the symbols were derived.**

1. What would you do to balance this reaction?



A. Double the coefficient of N_2 **(2 N_2)**

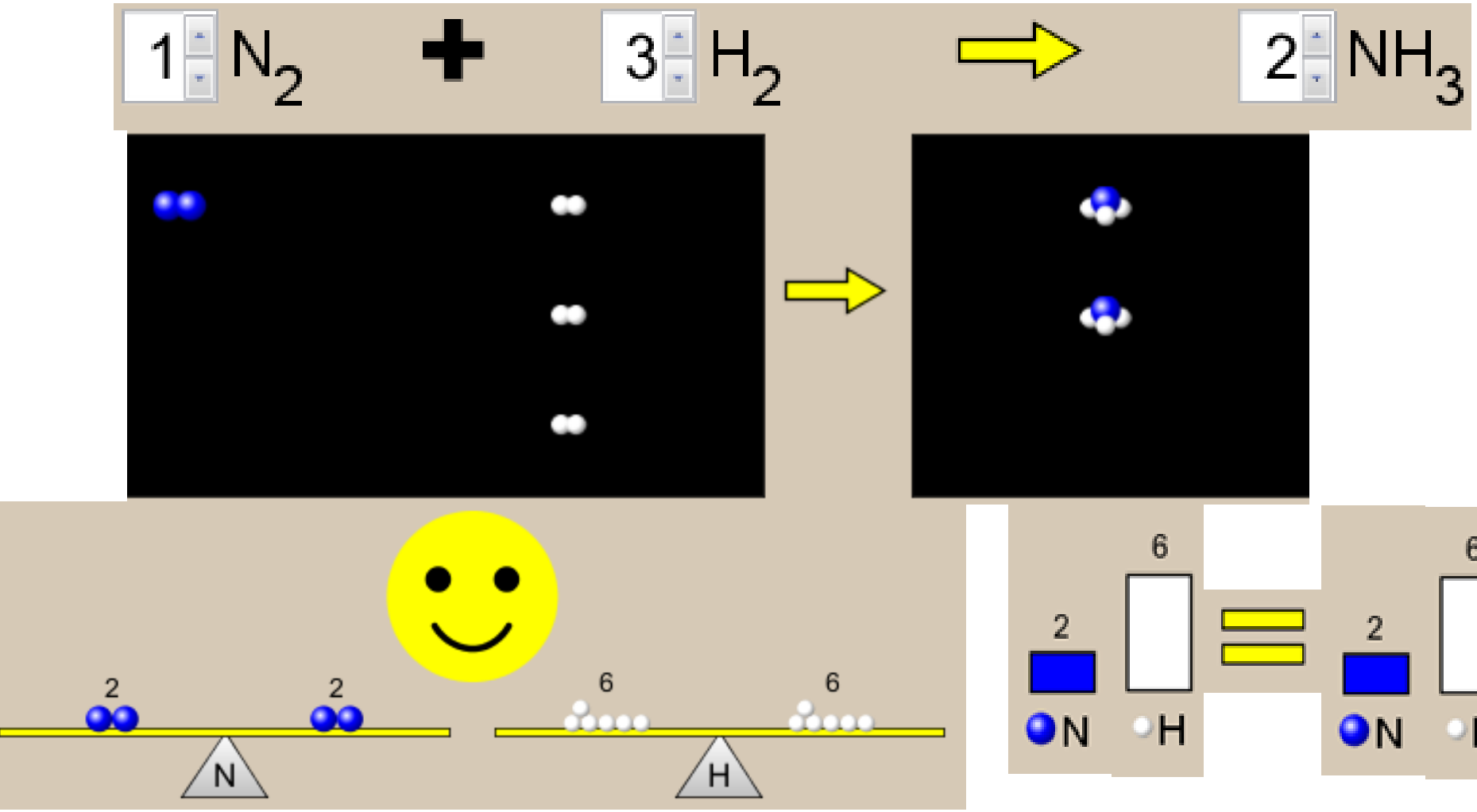
B. Multiply coefficient of H_2 by 3 **(3 H_2)**

C. Multiply subscripts of H_2 by 3 **(H_6)**

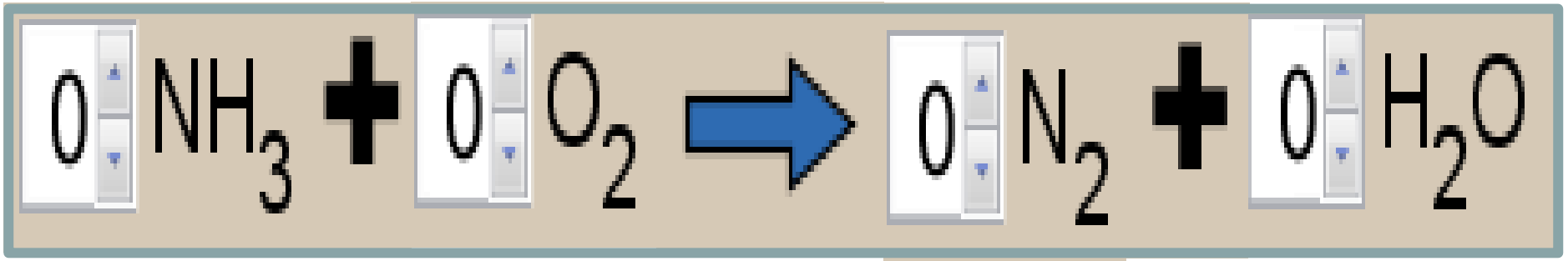
D. Double the subscripts for NH_3 **(N_2H_6)**

E. Double the coefficient of NH_3
($2NH_3$)

2. Which visual cues can you use on a test to see if your equation is balanced or not?



3. Which chemicals are **reactants**?



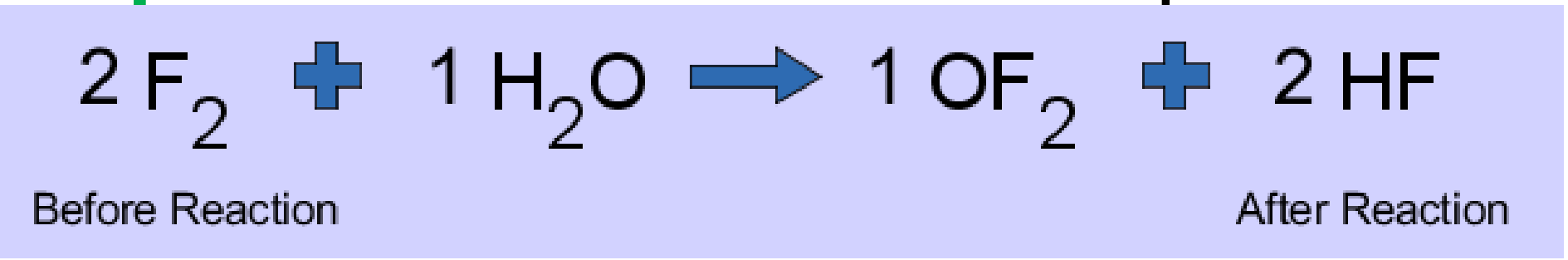
A. HN_3 and O_2

B. O_2 and H_2O

C. N_2 and H_2O

D. NH_3 and N_2

4. Which best describes the **products** of a chemical equation?



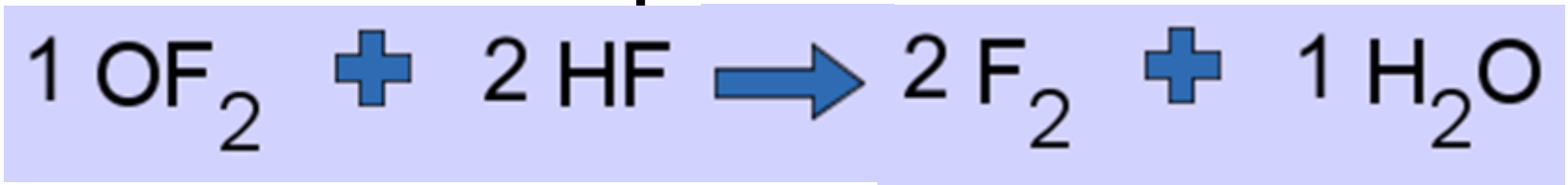
A. Chemicals before the reaction starts

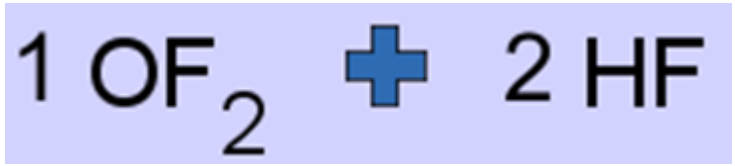
B. Chemicals after the reaction ends

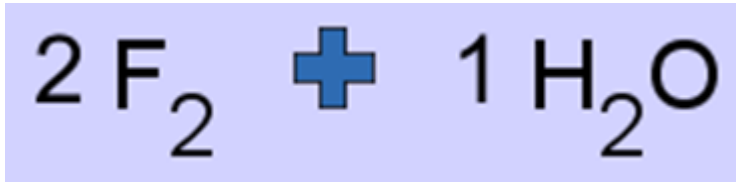
C. Chemicals on the left of the arr →

D. Chemicals on the right of the ar →

5. Which are the **products** of this chemical equation?



A. 

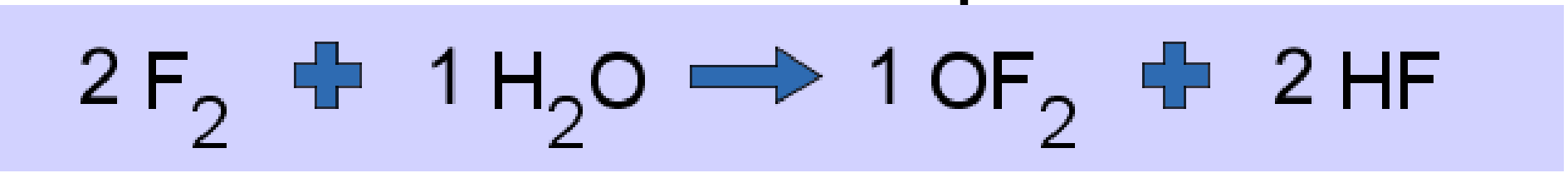
B. 

C.F_2 and H_2O

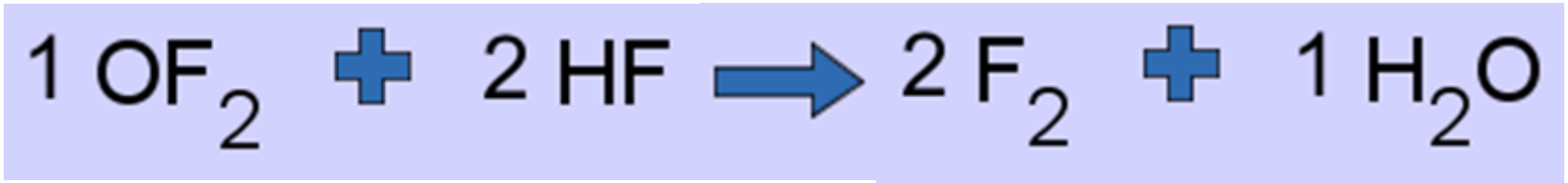
D.OF_2 and HF

E.More than 2 answers

Which best describes the **products** of a chemical equation?

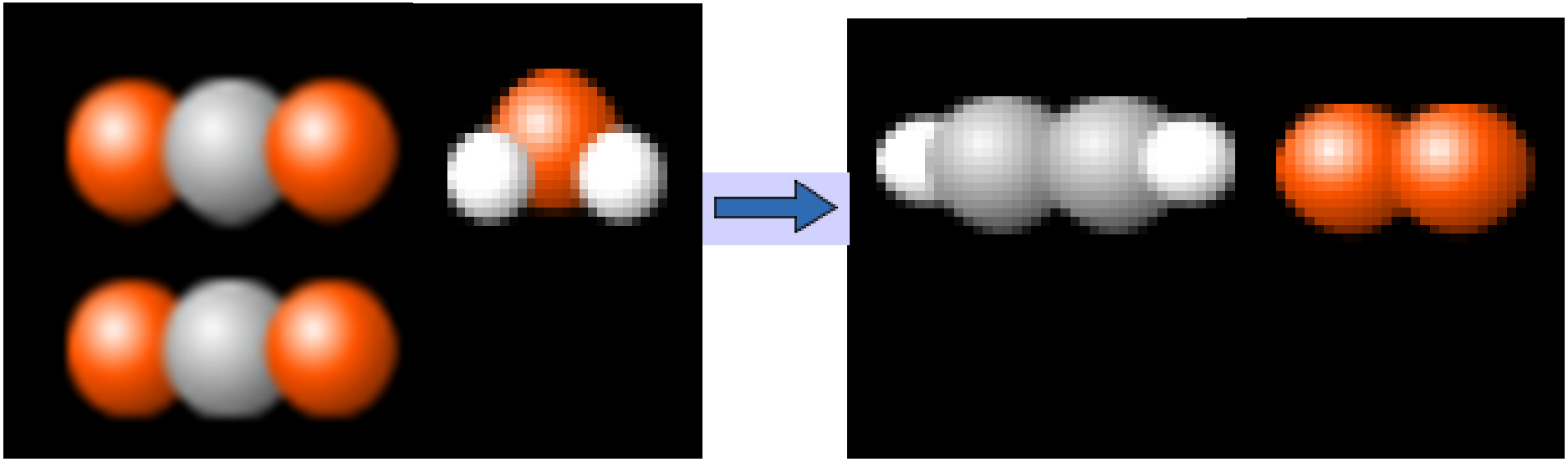


An author of a test or text may chose to write this reaction:



Lesson learned: ***Don't try to memorize reactions, analyze each one that is given.***

6. Is this reaction balanced?



A. Yes

B. No, there needs to be fewer red on the reactant side.

C. No, there needs to be more red on the product side.

D. No, for another reason.

Isotopes and Atomic Mass:

What does the mass on the periodic table mean?

By Trish Loeblein http://phet.colorado.edu

Learning Goals:

1. **Define "isotope" using mass number, atomic number, number of protons, neutrons and electrons**
2. **Compare and contrast: element, atom, isotope**
3. **Given the number of protons, neutrons and electrons, find the mass and name of an isotope**
4. **Given the name of an element and the number of neutrons, find the mass of an isotope**
5. **Give evidence to support or dispute: "In nature, the chance of finding one isotope of an element is the same for all elements."**
6. **Find the average atomic mass of an element given the abundance and mass of its isotopes**

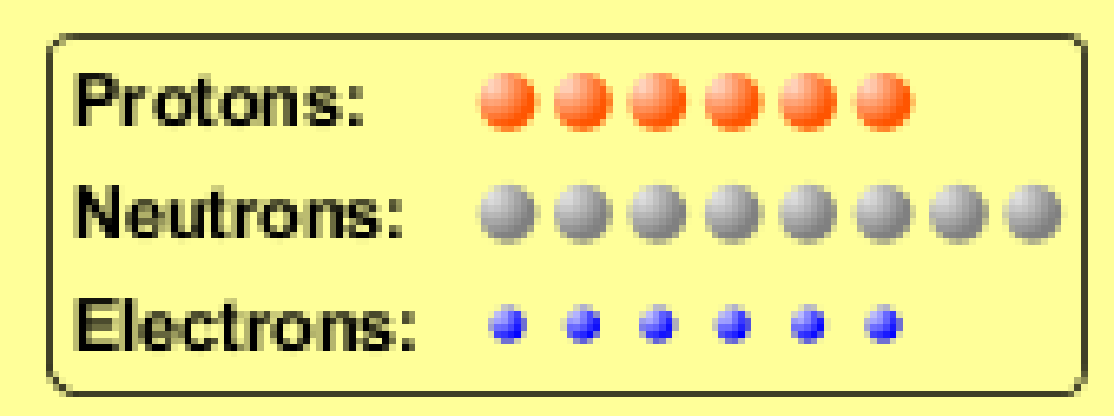
Pre-Lesson Discussion

- Calculate the average mass of the eggs in the container.
- Record the mass of each type of egg and the number of each.
- What is difference between the “Average Mass” and “Individual Mass”?
- Design a situation to make the mixture ____g

Post-Lesson Questions

What would this be?

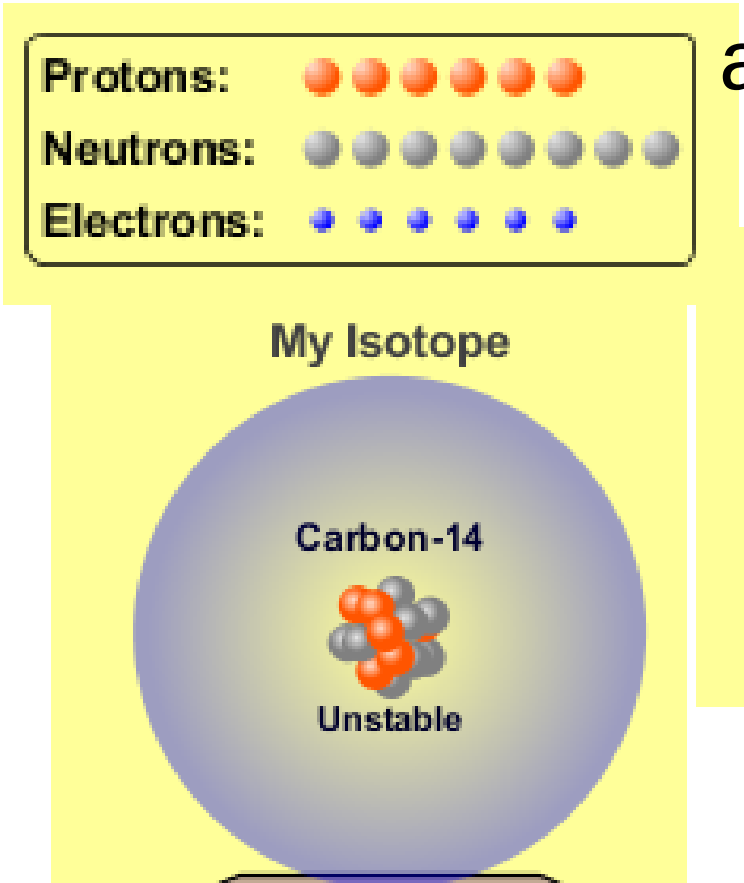
A. Carbon-12
B. Carbon-14
C. Oxygen-14
D. More than one of these



Reason: The number of protons tells the name of the atom; the mass is given by the sum of protons and neutrons.

$^{14}_{6}C$

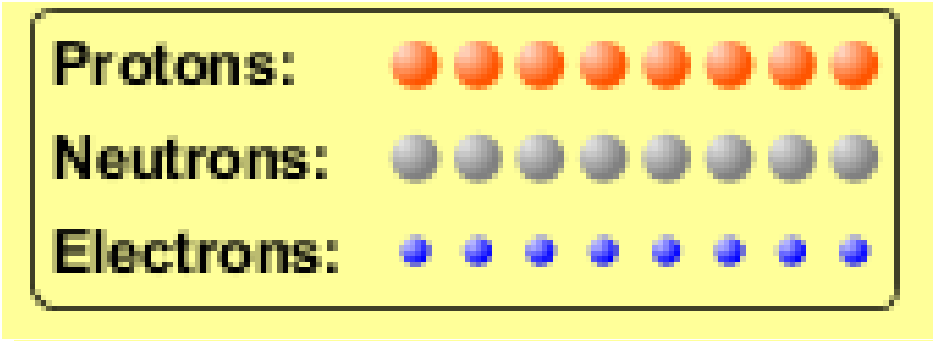
6 protons +8 neutrons = 14 amu



H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn						

Which would be isotopes?

1



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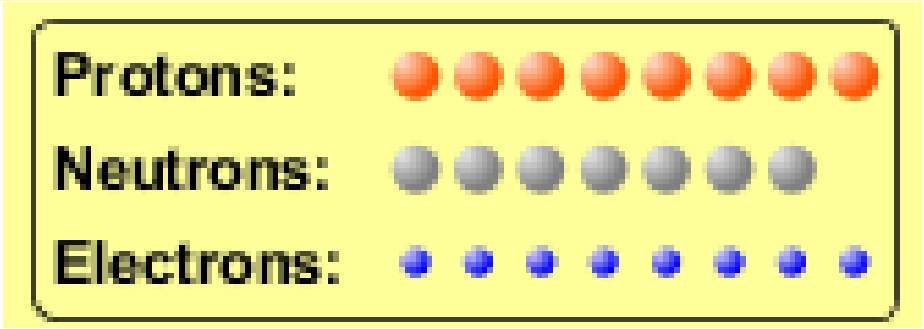

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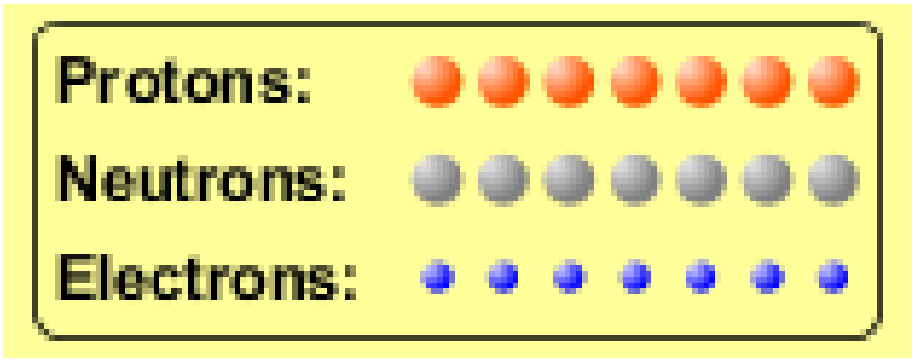
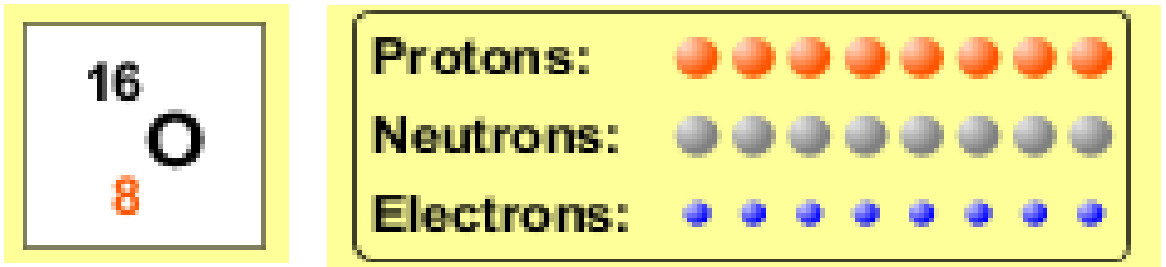


A. 1 & 2
B. 1 & 3
C. 2 & 3
D. none
E. more than one combination

Reason: Isotopes have same number of protons (so the same name), but different number of neutrons

1 and 2 are isotopes

1



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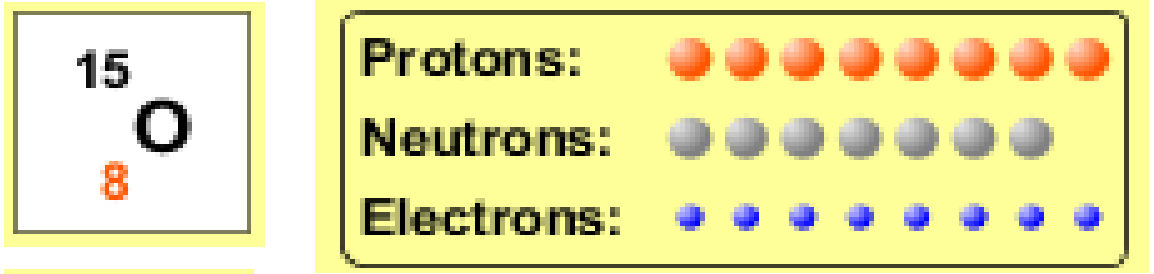

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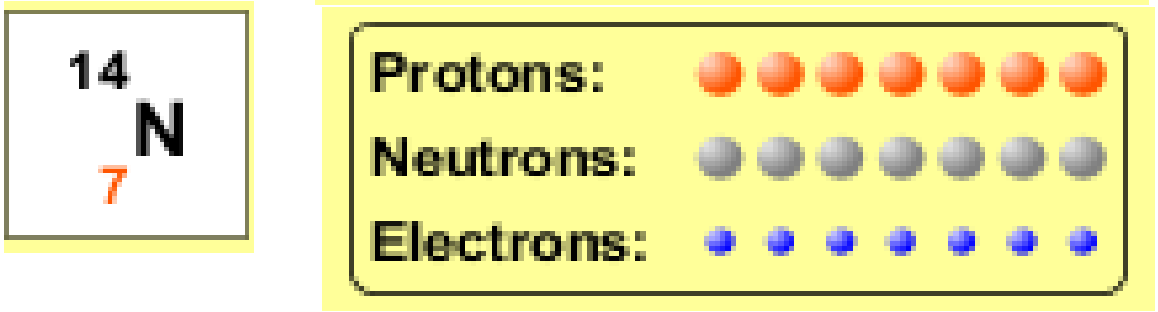
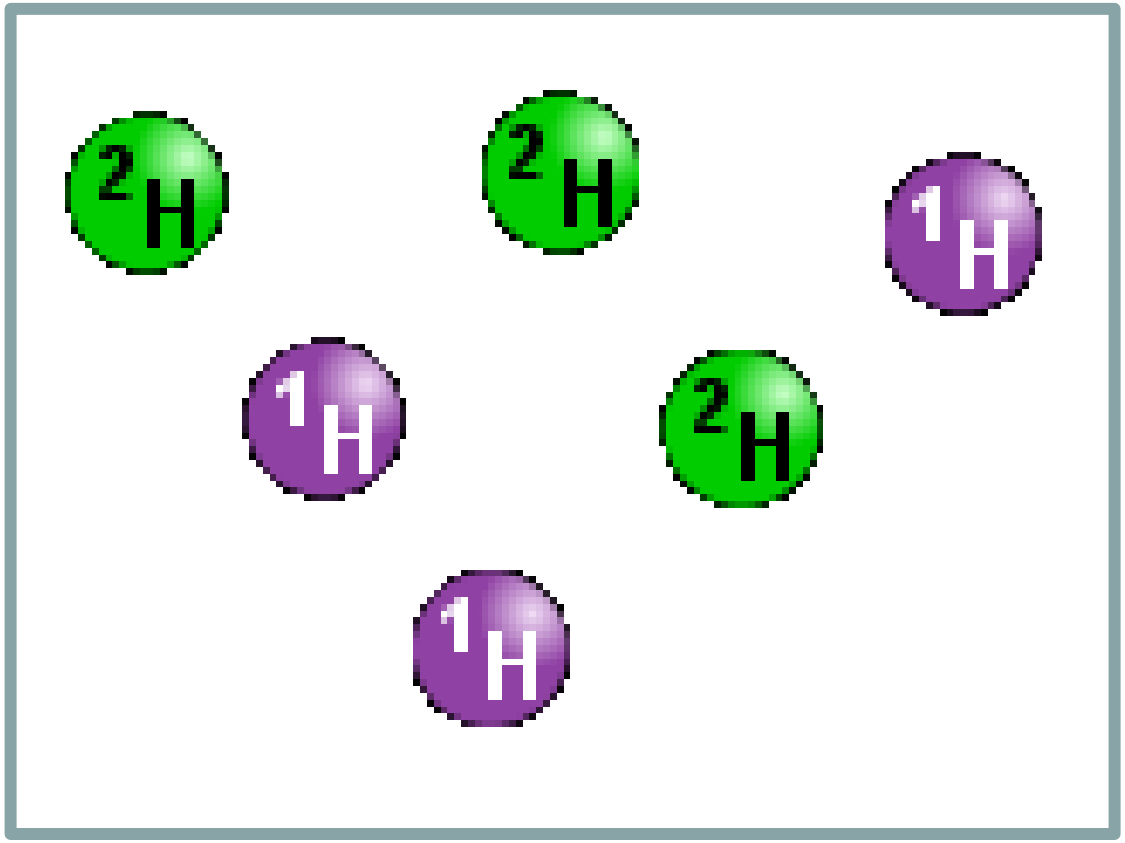


What would the approximate average mass of Hydrogen be?



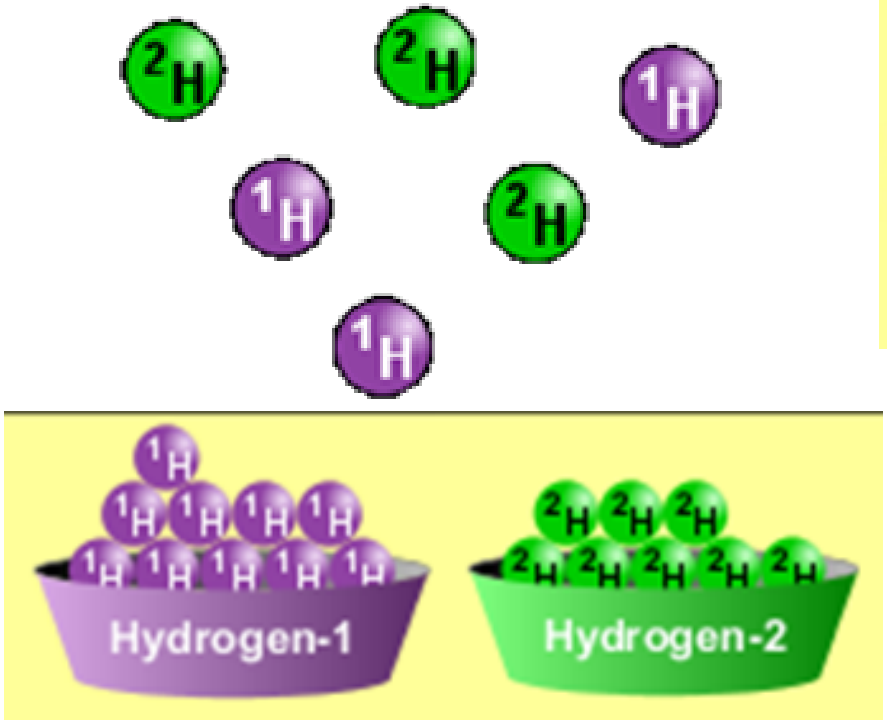
A. 6 amu

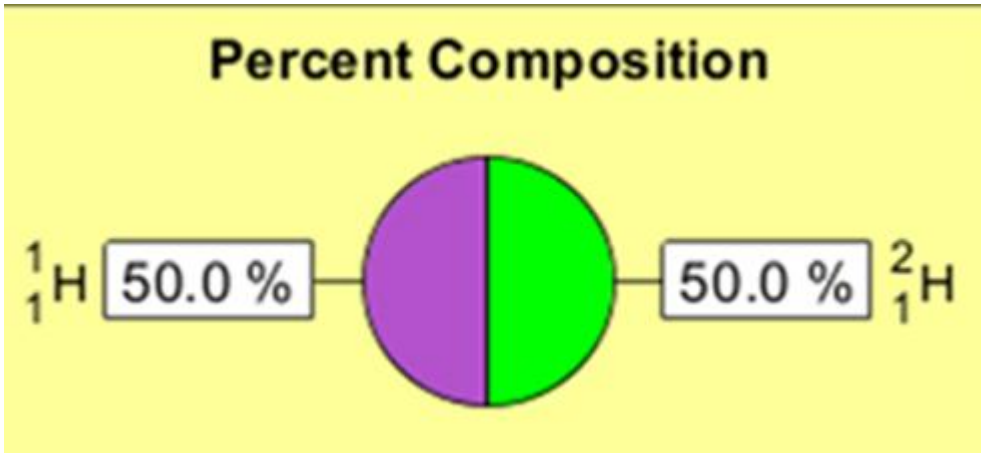
B. 2 amu

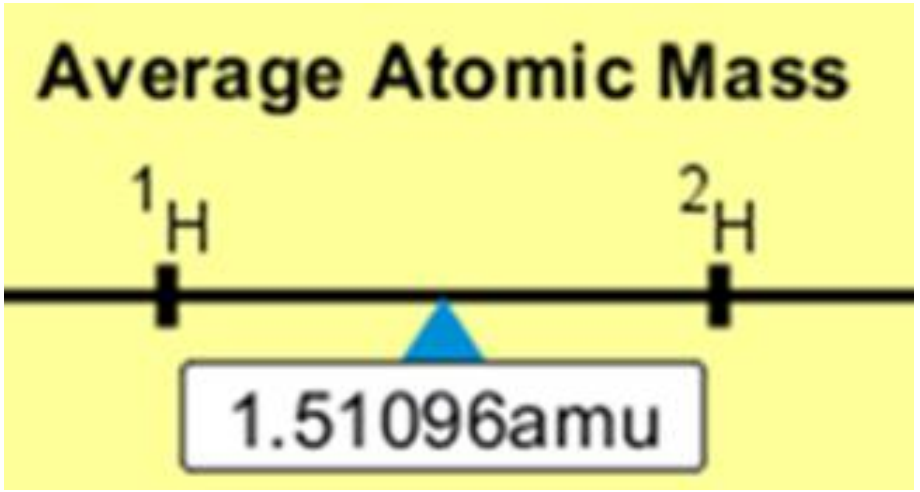
C. 1.5 amu

D. 1 amu

Reason: 3/6 gives 50% of each, so .5*2+.5*1=1.5 amu

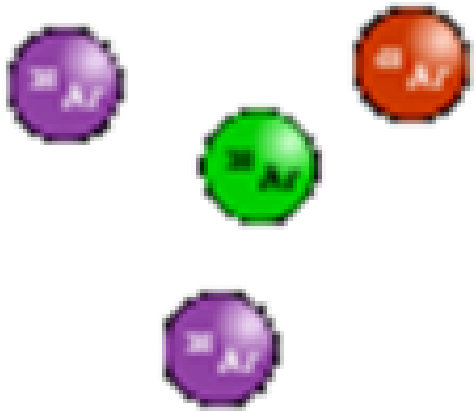






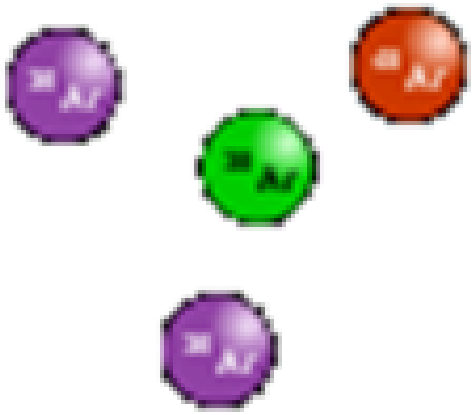
Why are there more digits in the answer in the sim?

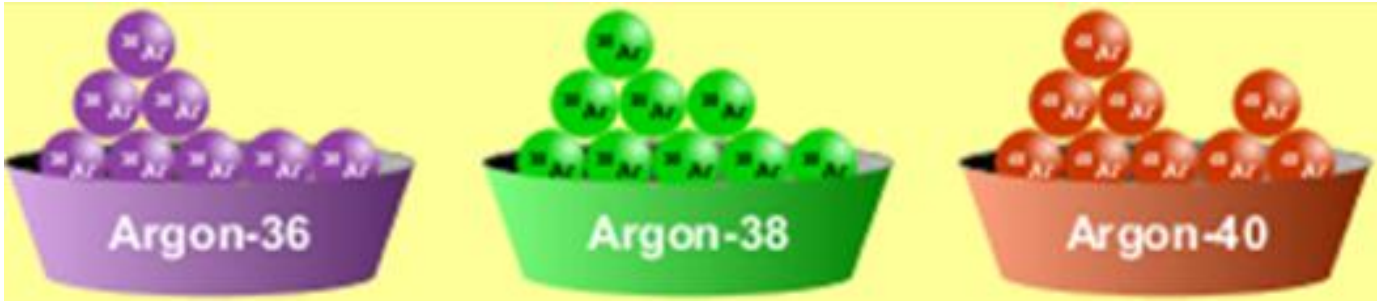
What would the approximate average mass of Argon be?

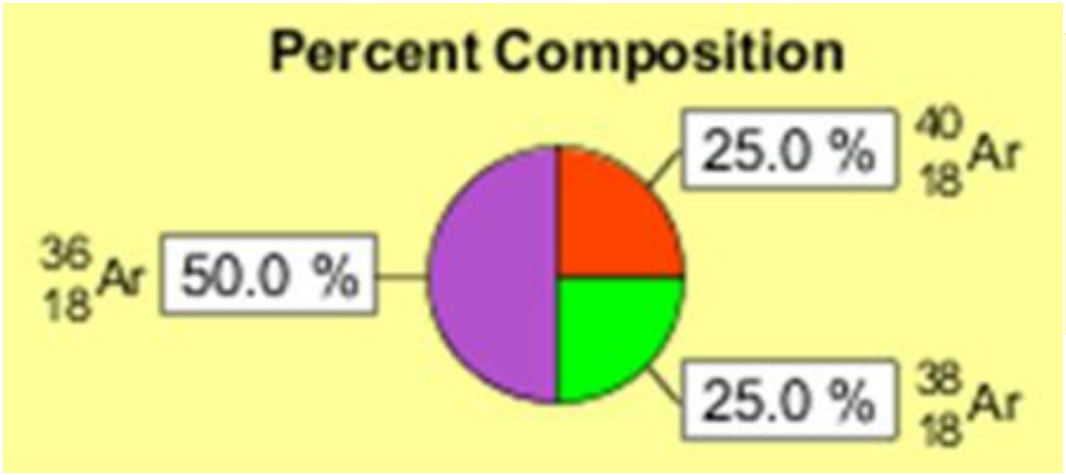


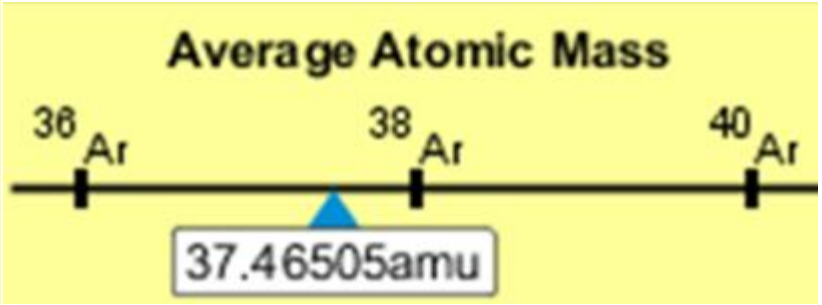
A. 40 amu B. 38 amu C. 37.5 amu

Reason: .5*36+.25*38+.25*40 =37.5

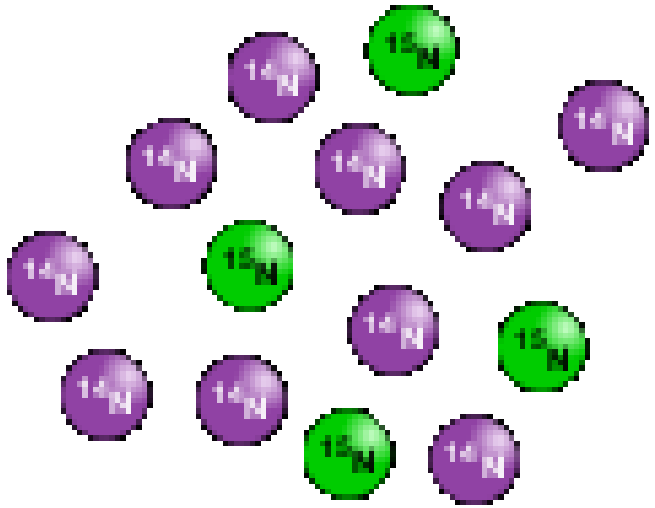


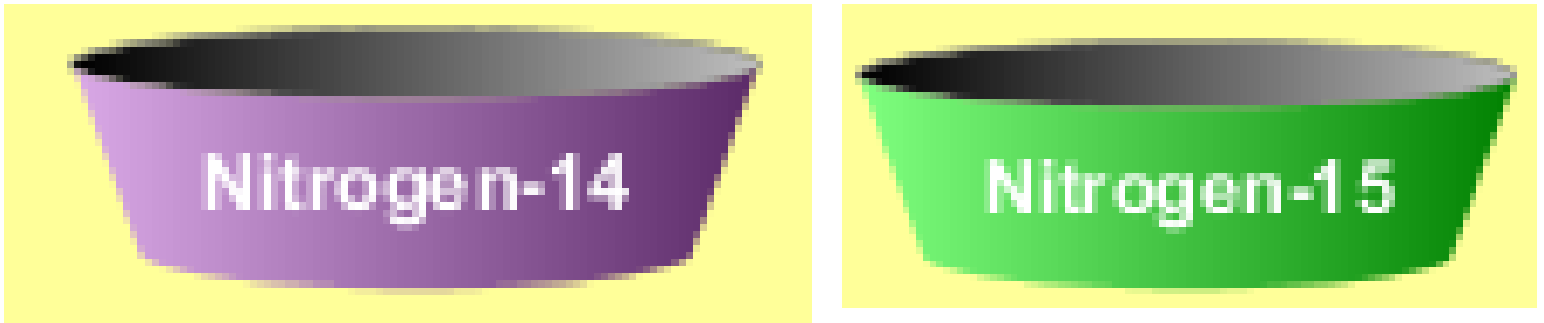






Discussion Questions: How would you know if this combination is likely to be found in some dirt?

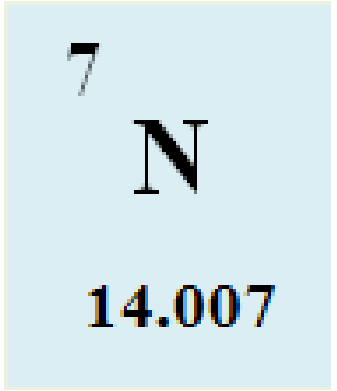




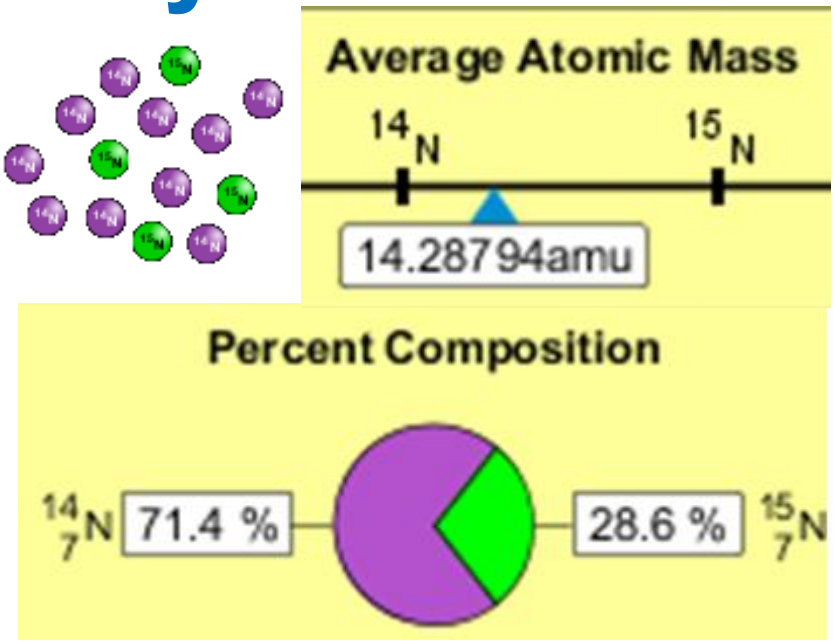
Reason:

10/14*14+4/14*15=14.285

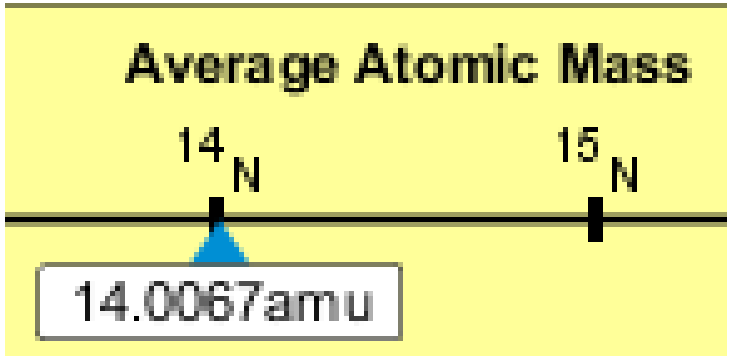
On the periodic table, the mass of Nitrogen is given as 14.007, so this is not the most common mixture found in nature.



"My Mixture"



"Nature's Mix"

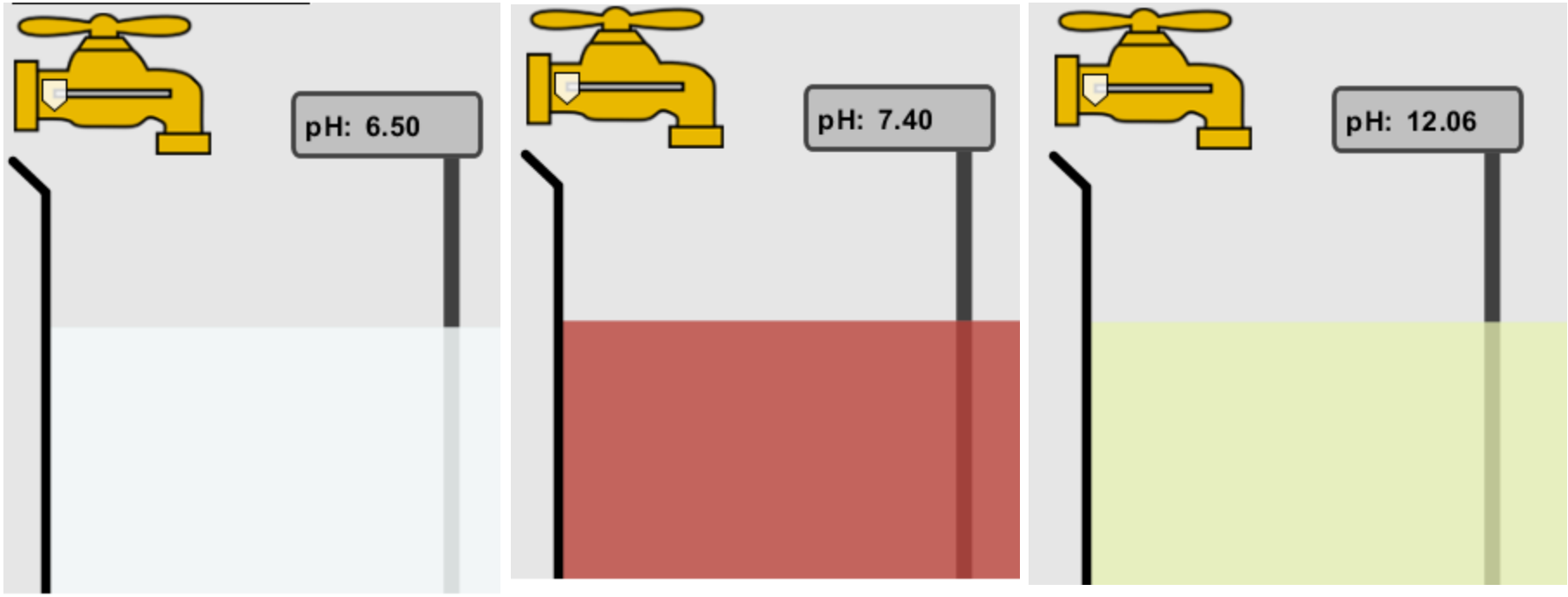


pH Scale: qualitative learning goals

1. Determine if a solution is acidic or basic using
   a) pH b) *H_3O^+/OH^- ratio* molecular size representation c) Hydronium/Hydroxide concentration
2. Relate liquid color to pH.
3. Predict if dilution and volume will increase, decrease or not change the pH
4. Organize a list of liquids in terms of acid or base strength in relative order with supporting evidence.
5. Write the water equilibrium expression. Describe how the water equilibrium varies with pH.

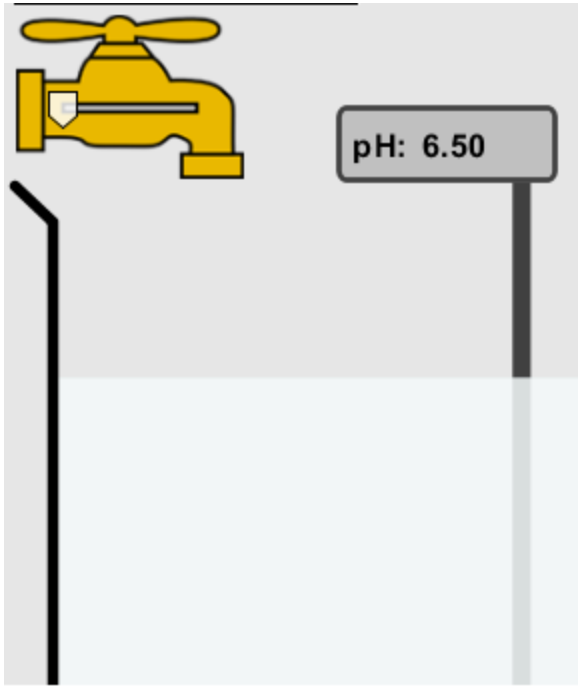
Trish Loeblein phet.colorado.edu

1. The color of a solution identifies if it is an acid, base, or neutral solution.

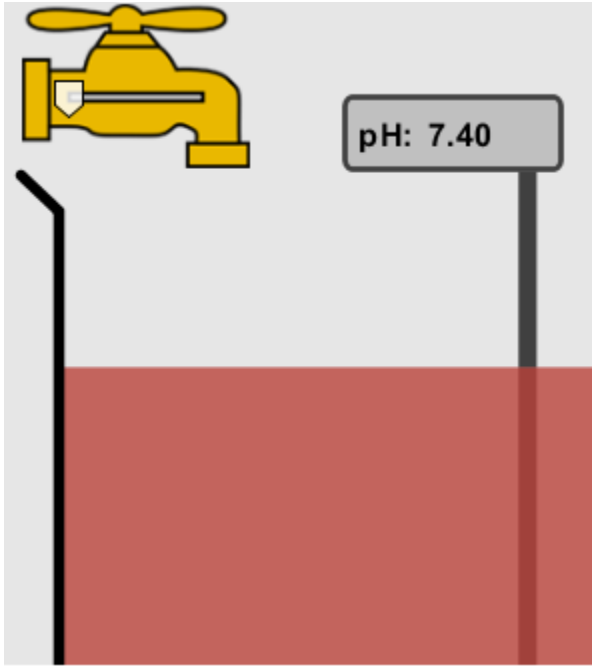


A. True B. False C. Pink are base and clear are acid

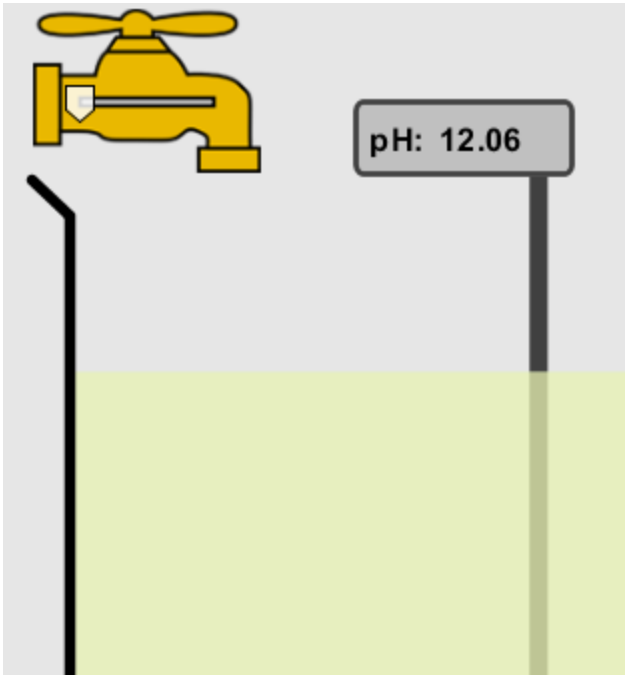
2. Which solution is basic?



A



B

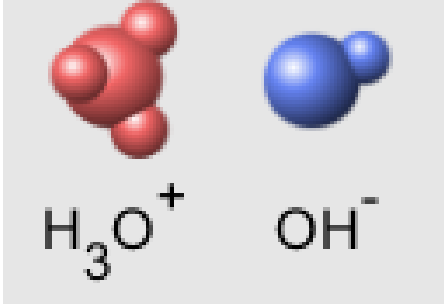


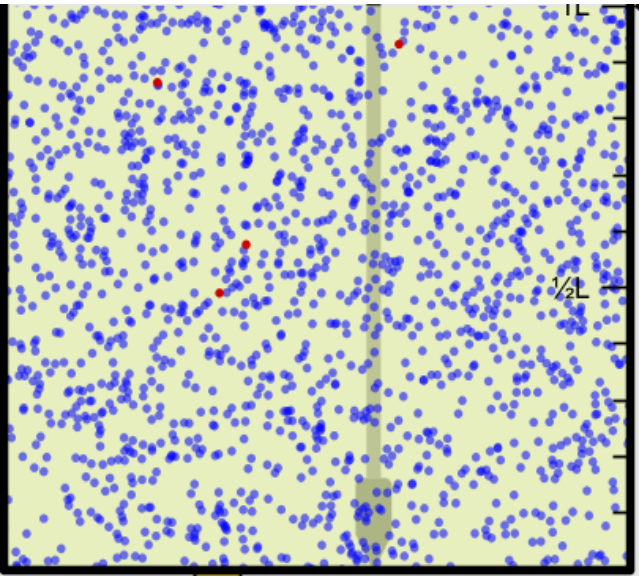
C

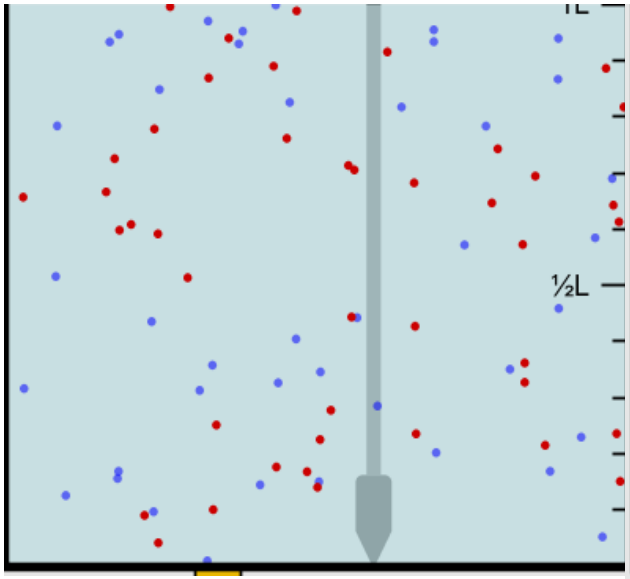
D. More than one

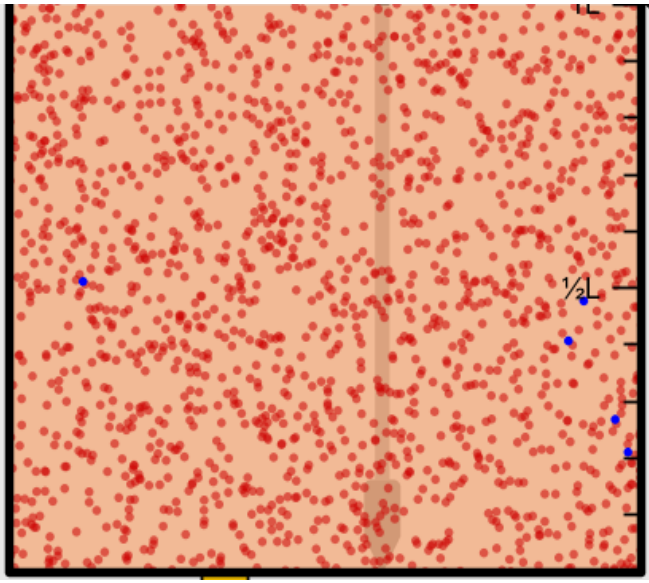
E. None

3. Which solution is acidic?





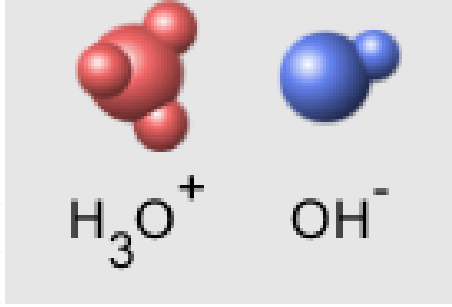


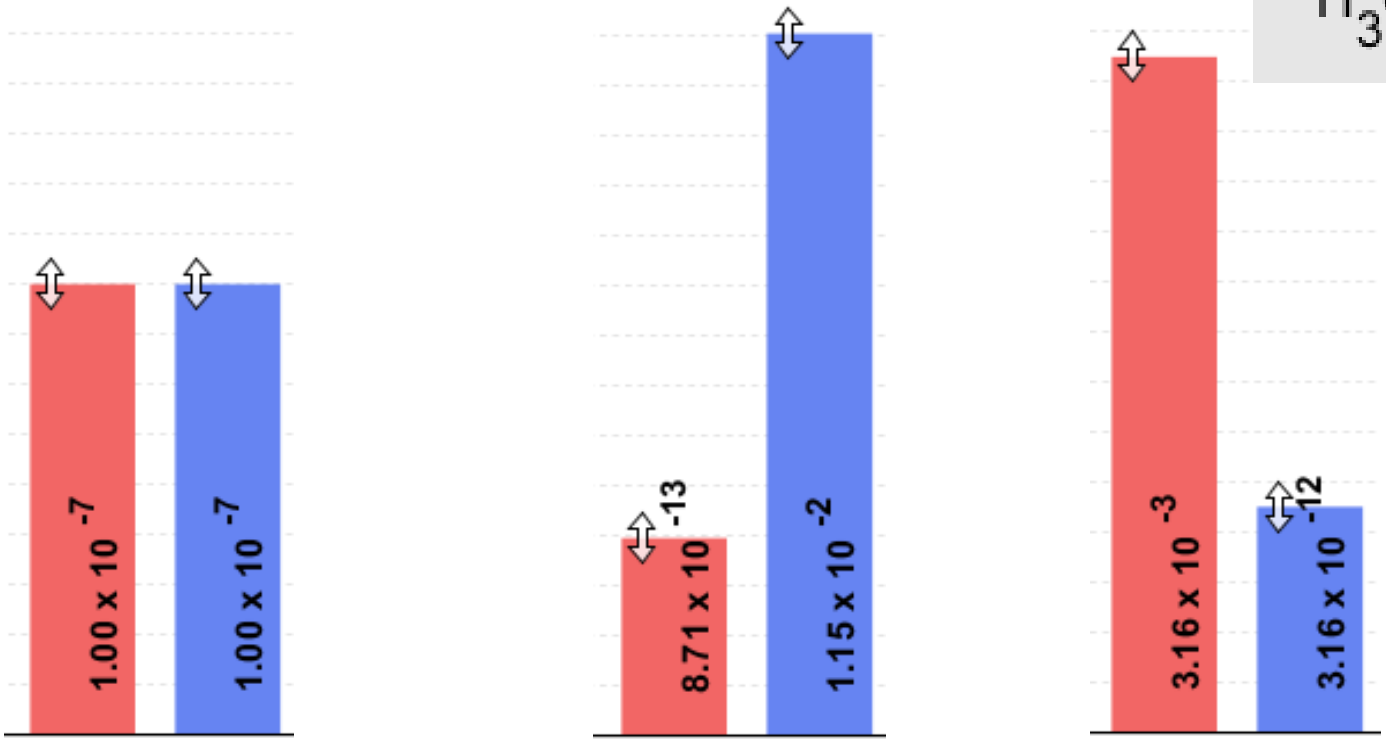


A B C

D. More than one E. Difficult to tell

4. Which solution is basic?

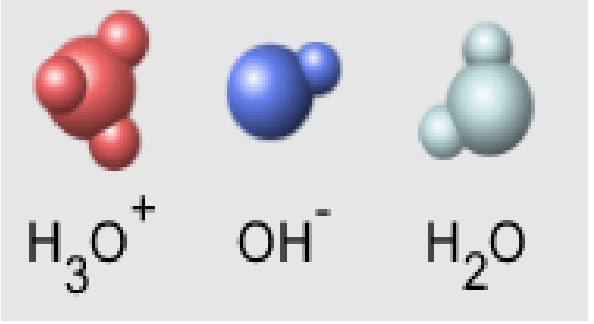


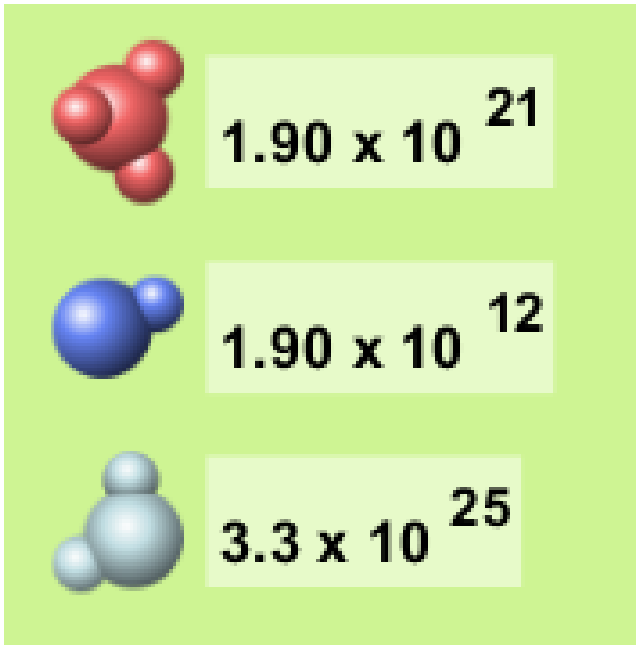


A B C

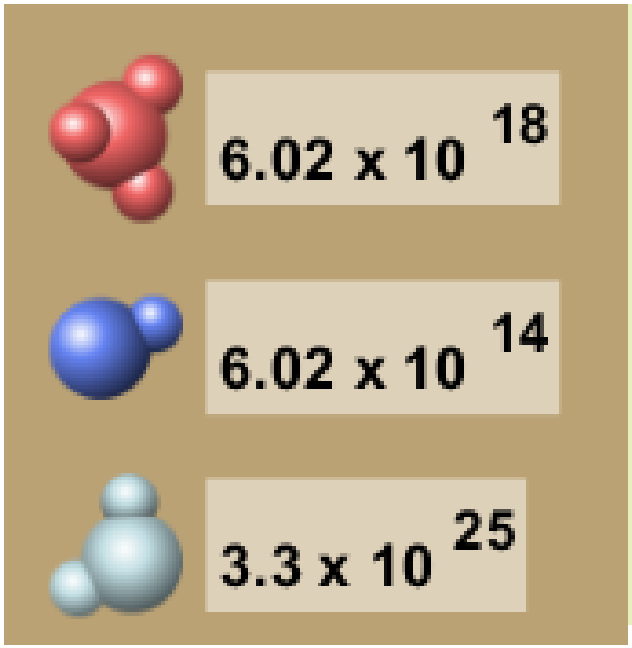
D. More than one E. None

5. Which solution is acidic?

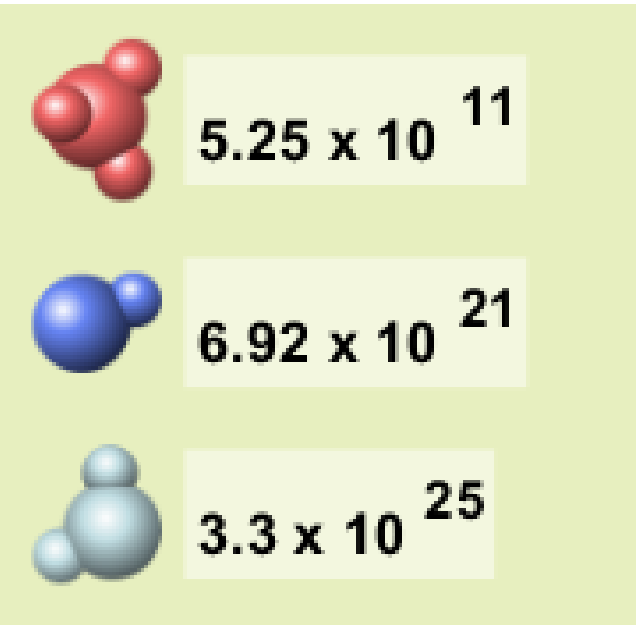




A



B



C

D. More than one

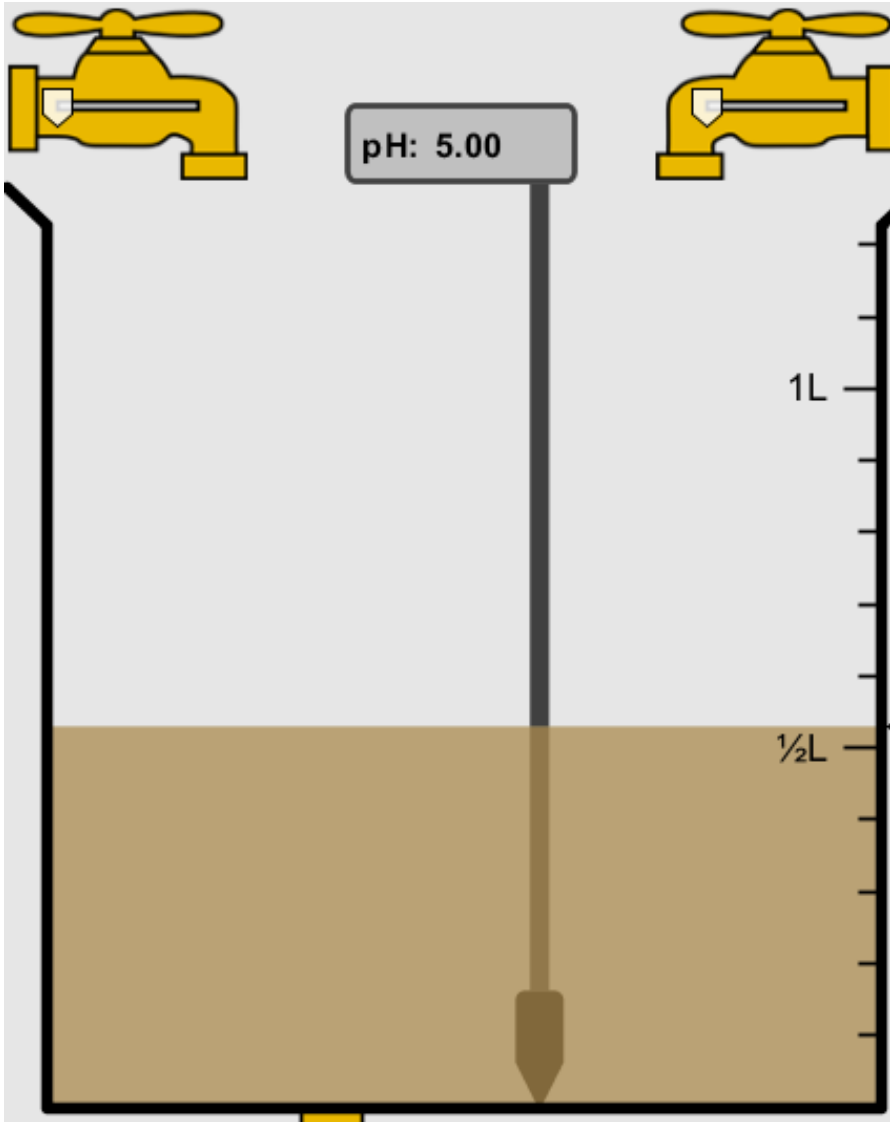
E. None

6. How will adding water effect the pH?

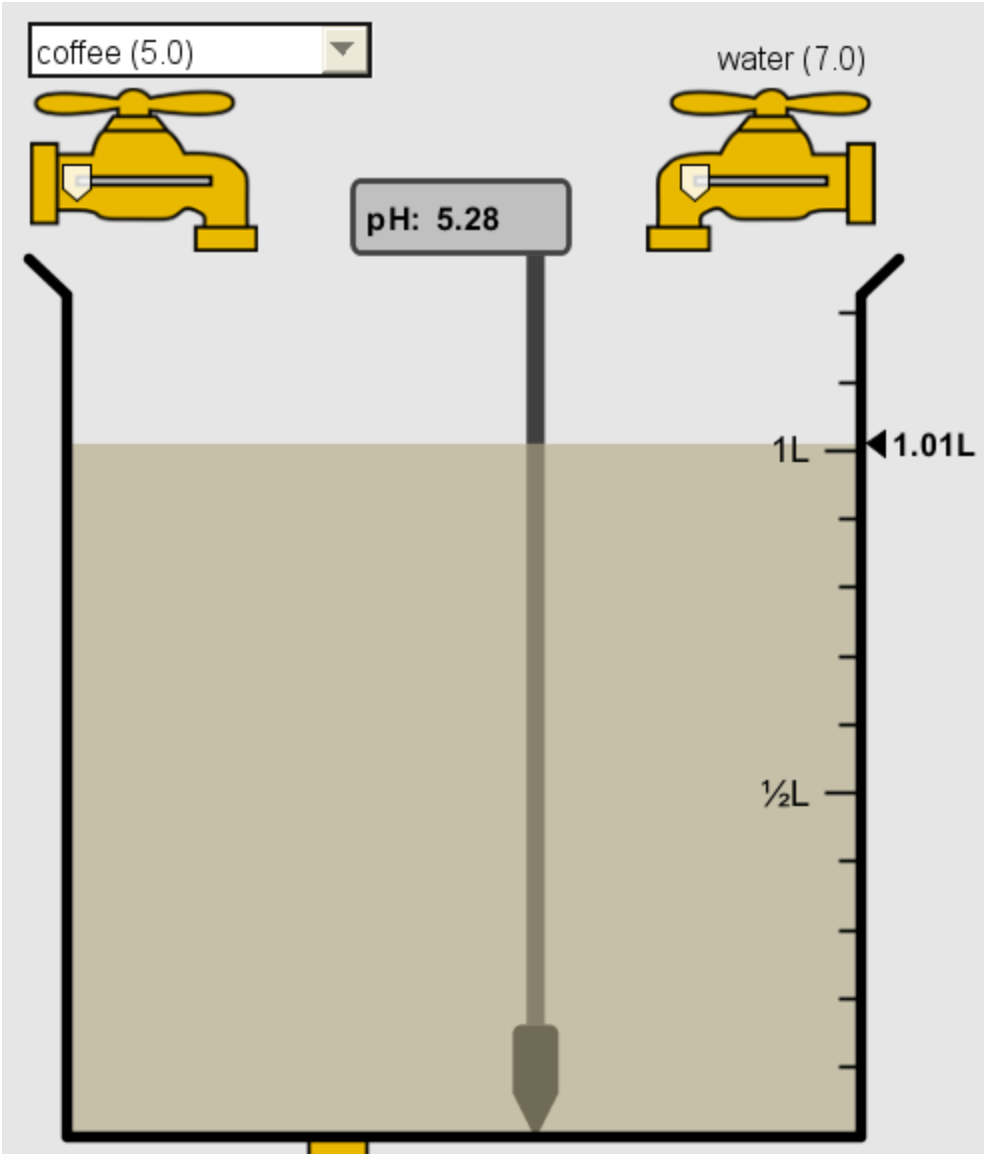
A. Increase the pH

B. Decrease the pH

C. No pH change



A: more water lessens the acidity, so pH goes up



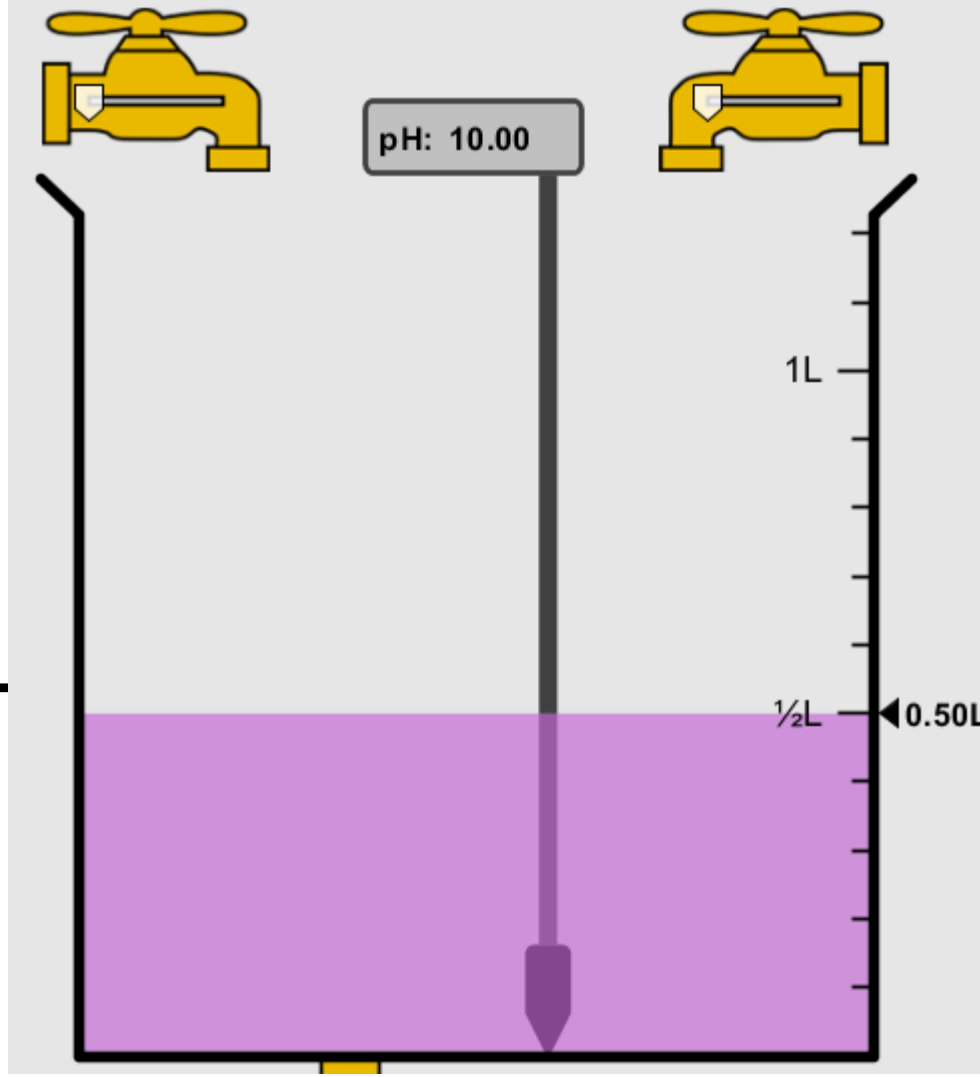
7. **How will equal amount of water effect the pH?**

A. Increase the pH

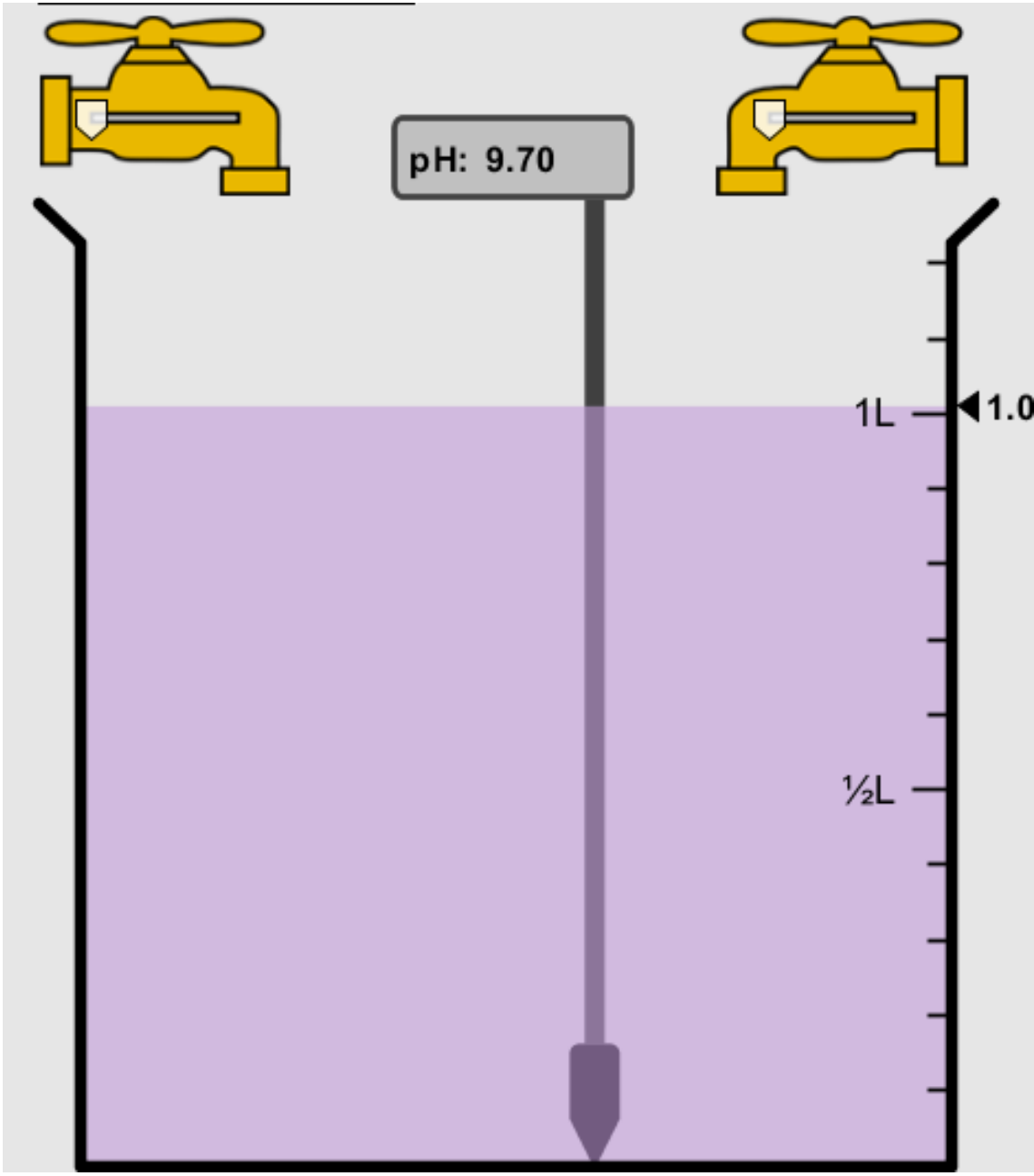
B. Decrease the pH

C. The pH will be cut in half

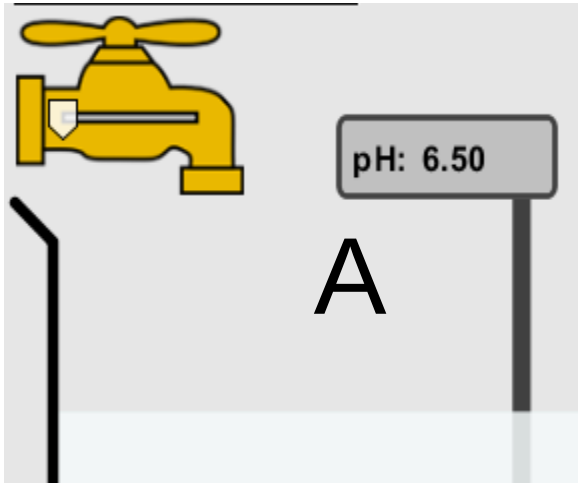
D. No pH change

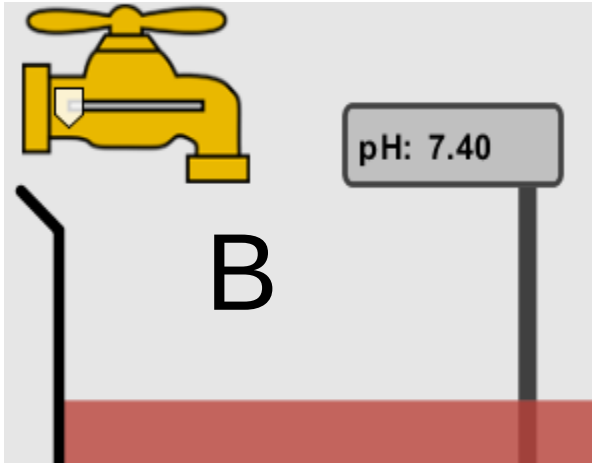


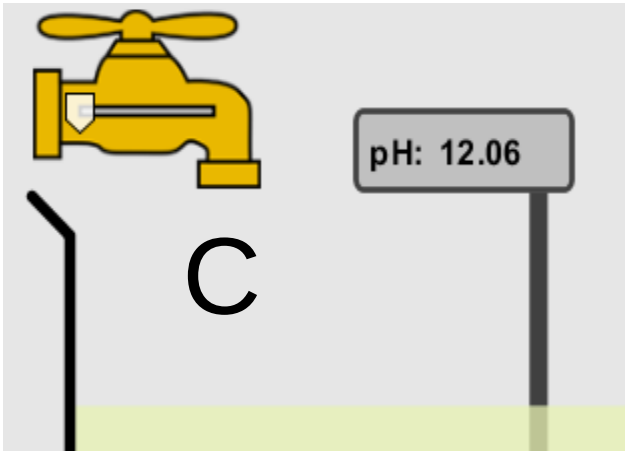
B: more water lessens the basicity , so pH goes down, from 10 to 9.7, but not by 2 (log scale)



8. What is the order from most acidic to most basic?







A. A B C

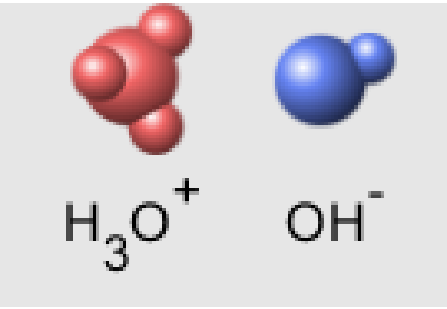
B. A C B

C. B A C

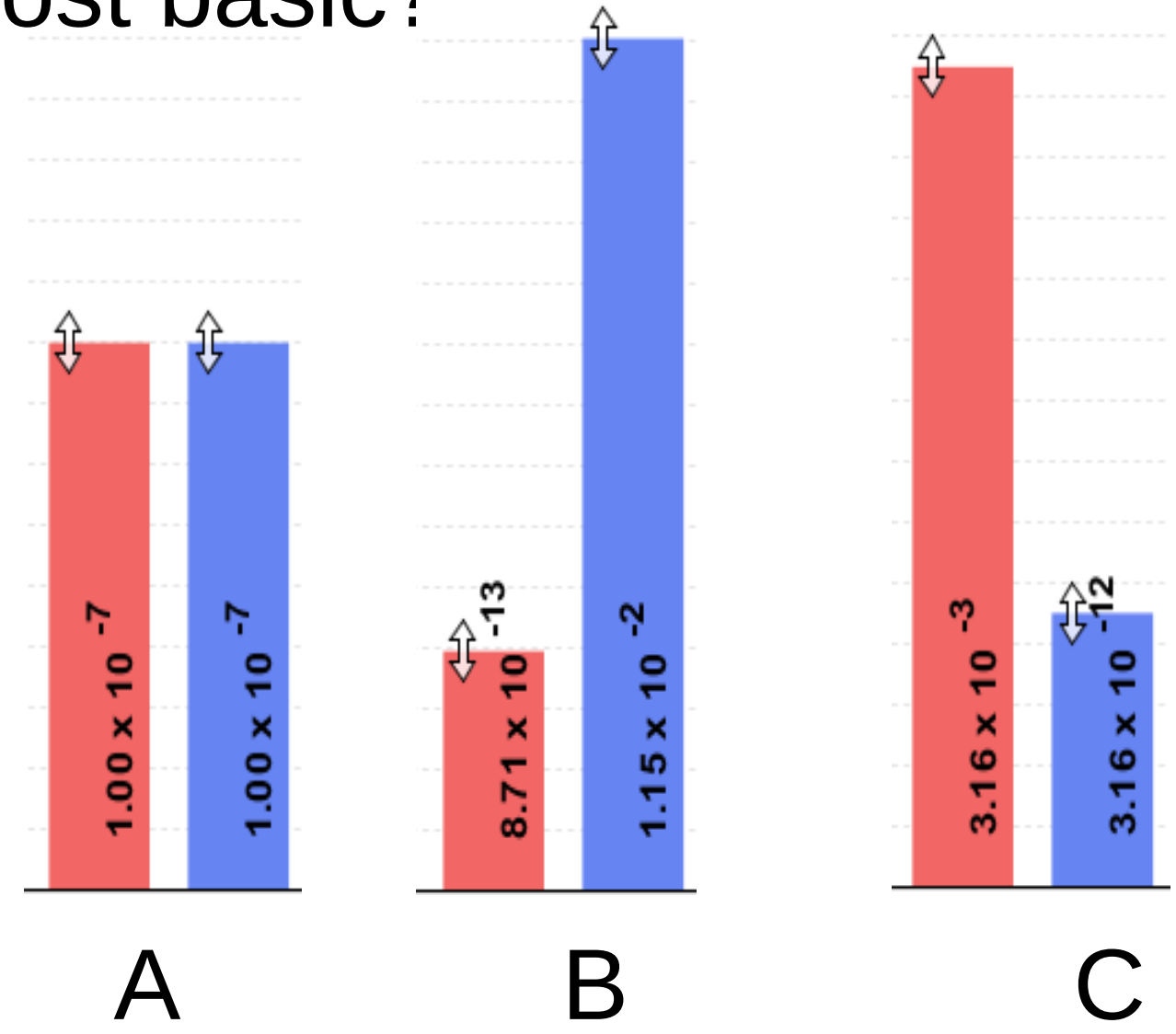
D. C B A

E. C A B

9. What is the order from most acidic to most basic?



A. A B C
B. A C B
C. B A C
D. C B A
E. C A B



10. If spit has a pH = 7.4, what does that tell you about the water equilibrium?

$$2H_2O \leftrightarrow OH^- + H_3O^+$$

A. Something was added that made the equilibrium shift left
B. Something was added that made the equilibrium shift right
C. pH has nothing to do with the water equilibrium

Answer to 10

Since the pH is not 7, then something was added to make the equilibrium shift left. For example, if NaOH was added to water, OH^- is immediately in the solution and some of it will react with the H_3O^+ , so the pH (which is inversely related to $[H_3O^+]$), goes up.

If something like HCl were added there would be more H_3O^+ , which would also cause a shift left, but there would be less OH^- , (which is directly related to pH), so the pH is less than 7.

Reactants, Products, and Leftovers Activity 1: **Introduction to Chemical reactions**

by Trish Loeblein http://phet.colorado.edu

Learning Goals:

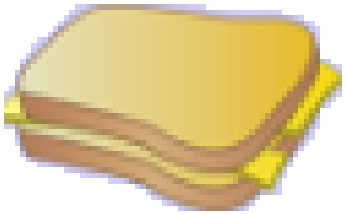
Students will be able to:

- Relate the real-world example of making sandwiches to chemical reactions
- Describe what “limiting reactant” means using examples of sandwiches and chemicals at a particle level.
- Identify the limiting reactant in a chemical reaction
- Use your own words to explain the Law of Conservation of Particles means using examples of sandwiches and chemical reaction

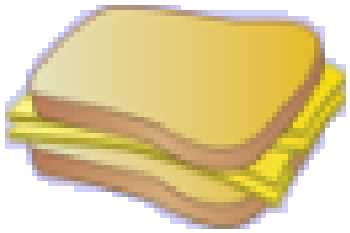
1. Making a cheese sandwich can be represented by the chemical equation:

$$2\ Bd + Ch \rightarrow Bd_2Ch$$

What would you expect a sandwich to look like?



A



B

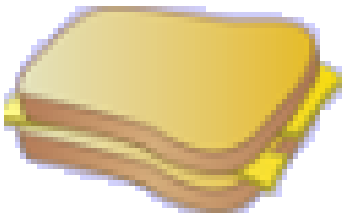
C

D

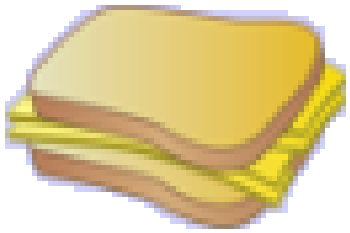
2. Making a cheese sandwich can be represented by the chemical equation:

$$Bd_2 + 2Ch \rightarrow 2BdCh$$

What would you expect a sandwich to look like?



A



B

C

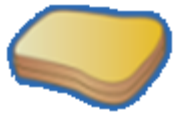
D

3. Making a cheese sandwich can be represented by the chemical equation:

$2\ Bd + Ch \rightarrow Bd_2Ch$

What does the "2" on the *left* side of the chemical equation represent?

A. 2 pieces of bread stuck together



B. 2 separate pieces of bread

C. 2 loaves of bread

4. Making a cheese sandwich can be represented by the chemical equation:

$$Bd_2 + 2Ch \rightarrow 2BdCh$$

What does the "2" on the *left* side of the chemical equation represent?

A. 2 pieces of bread stuc together

B. 2 separate pieces of bread

C. 2 loaves of bread

5. A menu at the Chemistry Café shows a sandwich: BdM_2Ch

What would you expect a sandwich to have?

A. 2 pieces of bread, 2 pieces of meat, 1 piece of cheese

B. 1 piece of bread, 2 pieces of meat, 1 piece of cheese

C. 2 loaves of bread

6. A menu at the Chemistry Café describes a sandwich as 3 pieces of bread, one meat and 2 cheeses.

What would you expect a sandwich name to be?

A. Bd_2MCh_2

B. Bd_3M_2Ch

C. Bd_3MCh_2

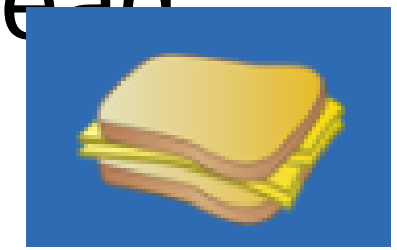
7. The Chemistry Café owner was out of bread. She went to the bakery next door and bought a loaf which had 33 slices. Then she sells 12 sandwiches, which need 2 pieces of bread each. How much bread did she have left?

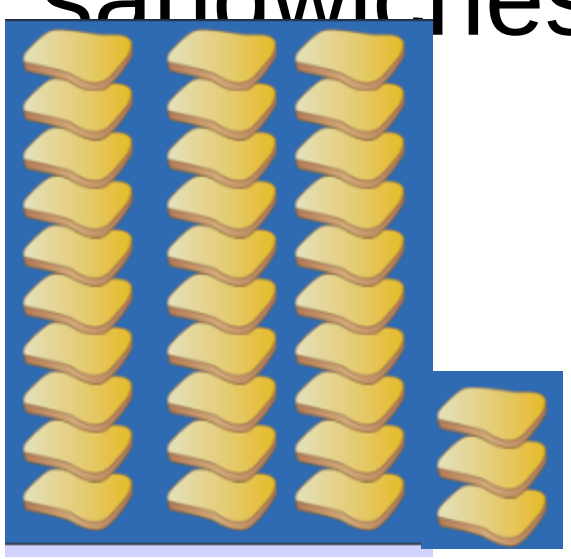
A. 21

B. 9

C. None, she gave the leftovers to the birds

8. The Chemistry Café cook has a loaf which had 33 slices and a package of cheese that has 15 slices. He is making sandwiches that have 2 pieces of both bread and cheese. How many sandwiches can he make?





A.16

B.15

C.7

Reactants, Products, and Leftovers

Activity 2: **Limiting Reactants in Chemical reactions**

by Trish Loeblein http://phet.colorado.edu

(assuming complete reactions)

Learning Goals: Students will be able to:

- Predict the amounts of products and leftovers after reaction using the concept of limiting reactant
- Predict the initial amounts of reactants given the amount of products and leftovers using the concept of limiting reactant
- Translate from symbolic (chemical formula) to molecular (pictorial) representations of matter
- Explain how subscripts and coefficients are used to solve limiting reactant problems.

1. **A mixture of 4 moles of H_2 and 3 moles of O_2 reacts to make water. Identify: limiting reactant, excess reactant, and how much is unreacted.**

	Limiting reactant	Excess reactant
A.	H_2	1 mole H_2
B.	H_2	1 mole O_2
C.	O_2	1 mole H_2
D.	O_2	1 mole O_2

E. No reaction occurs since the equation does not balance with 4 mole H_2 and 3 mole O_2

2. **A mixture of 6 moles of H_2 and 2 moles of O_2 reacts to make water. How much water is made?**

A. 6 moles water

B. 2 moles water

C. 3 moles water

D. 4 moles water

E. No reaction occurs since the equation does not balance with 6 mole H_2 and 2 mole O_2

3. **A mixture of 2.5 moles of Na and 1.8 moles of Cl_2 reacts to make NaCl. Identify: limiting reactant, excess reactant, and how much is unreacted.**

	Limiting reactant	Excess reactant
A.	Na	0.7 mole Na
B.	Na	0.7 mole Cl_2
C.	Na	0.55 mole Cl_2
D.	Cl_2	0.7 mole Na
E.	Cl_2	1 mole Na

4. **A mixture of 2.5 moles of Na and 1.8 moles of Cl_2 reacts to make NaCl. How much sodium chloride is made?**

A. 2.5 moles NaCl

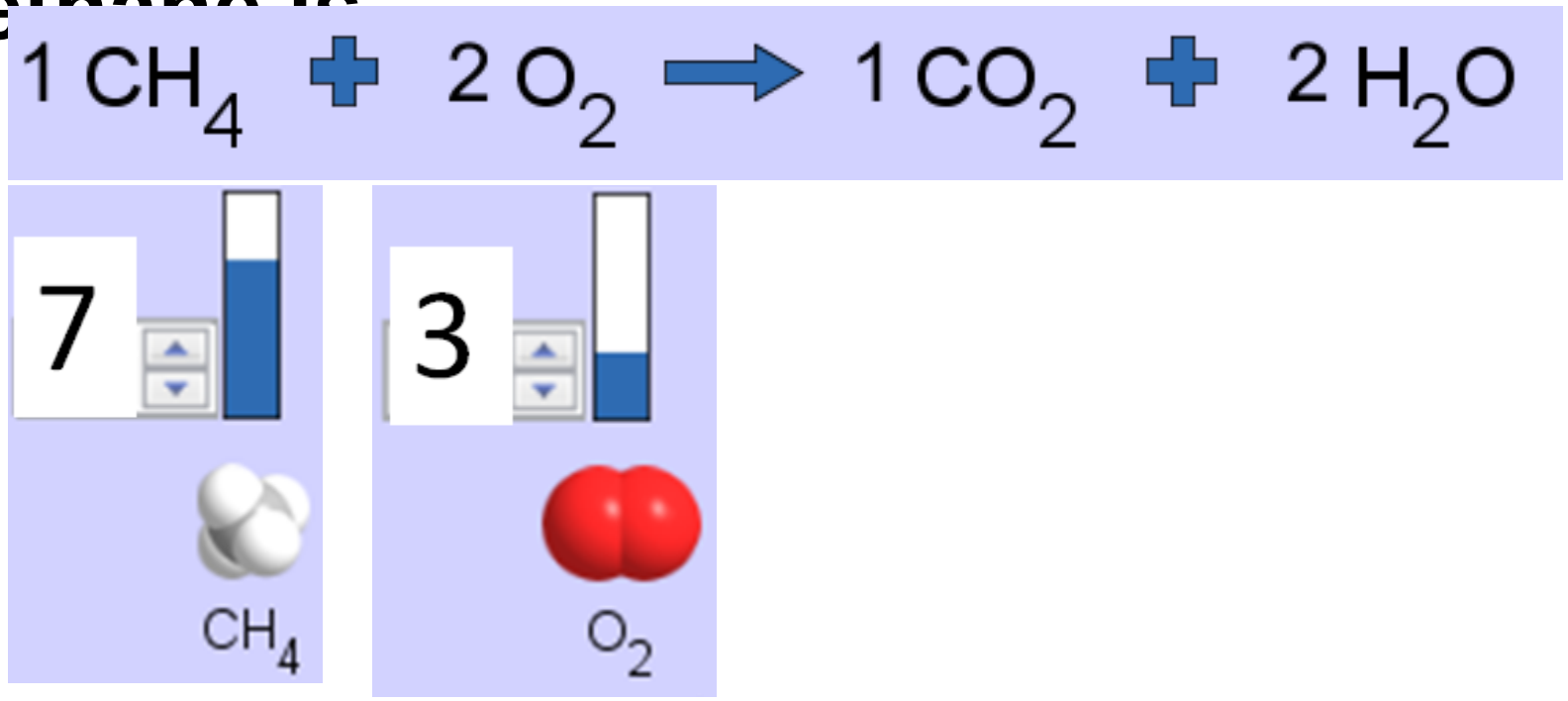
B. 1.8 moles NaCl

C. 0.7 moles NaCl

D. 0.55 moles NaCl

E. 1 mole Nacl

5. The reaction for combustion of methane is

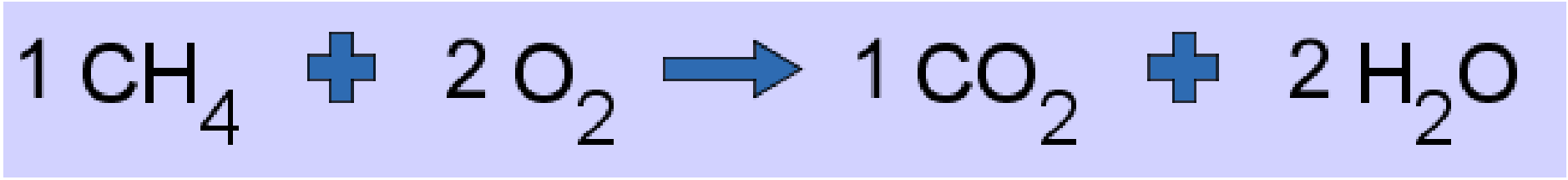


Given the shown amounts for each reactant, predict the amounts of products and leftovers after complete reaction.

5. **What are the amounts after the reaction?**

Initial:

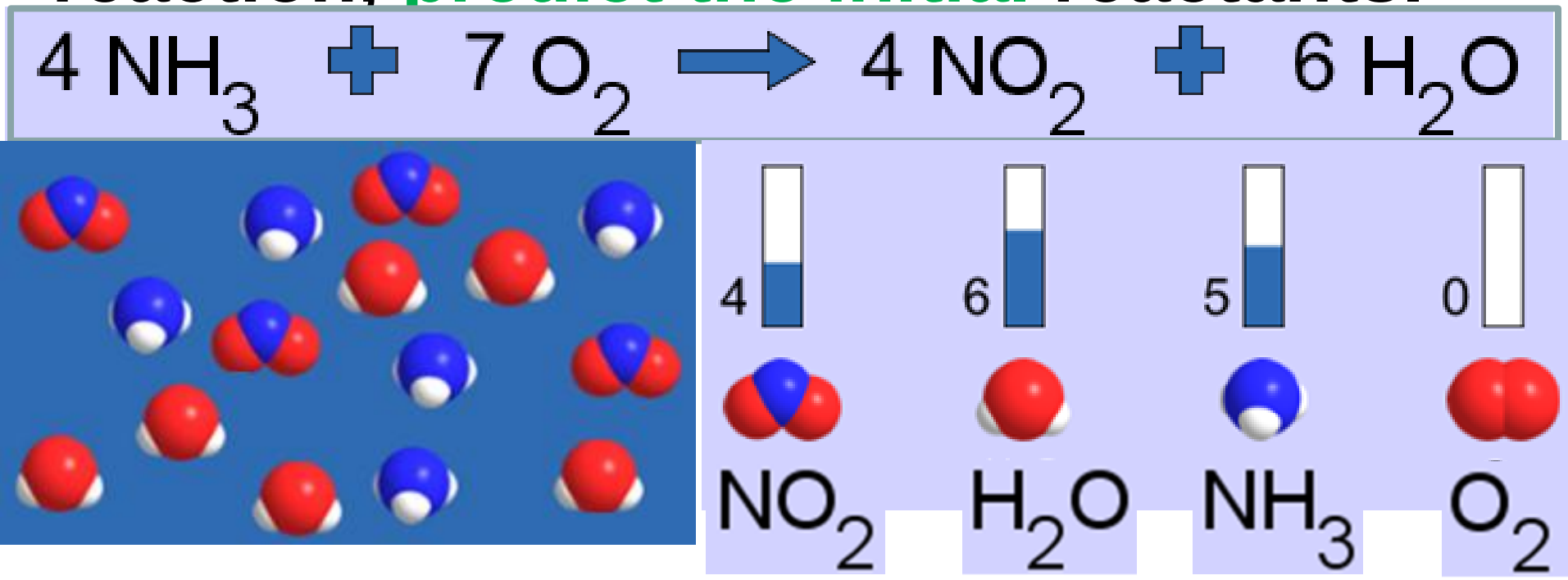
7 CH_4 and 3 O_2



After:

A. 6	**1**	**1**	**2**
B. 1	**6**	**1**	**2**
C. 1	**0**	**6**	**12**
D. 4	**0**	**4**	**8**

6. **Given the shown amounts for the products and leftovers after a complete reaction, predict the initial reactants.**



6. What are the amounts before the reaction?

After:




5 NH_3 0 O_2 4 NO_2 6 H_2O

$4\ NH_3 + 7\ O_2 \rightarrow 4\ NO_2 + 6\ H_2O$

A. 4

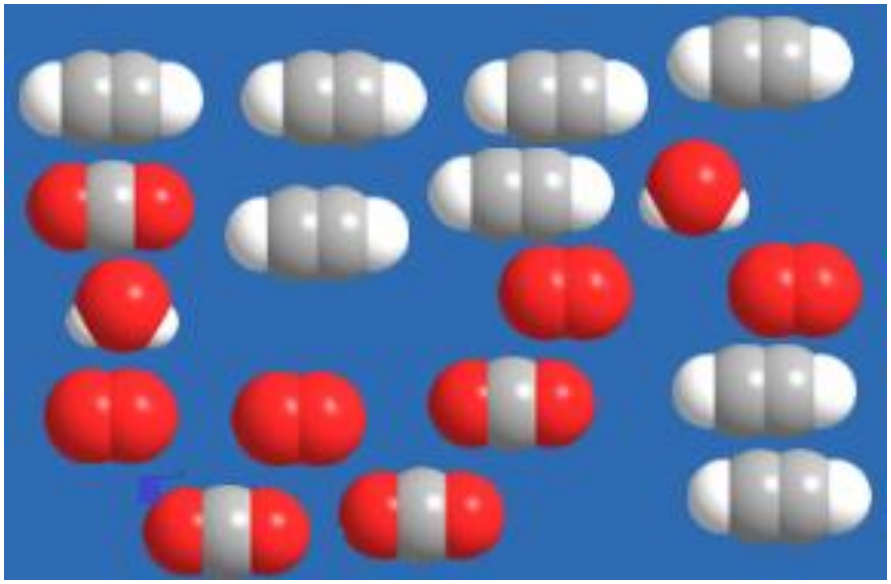

B. 9

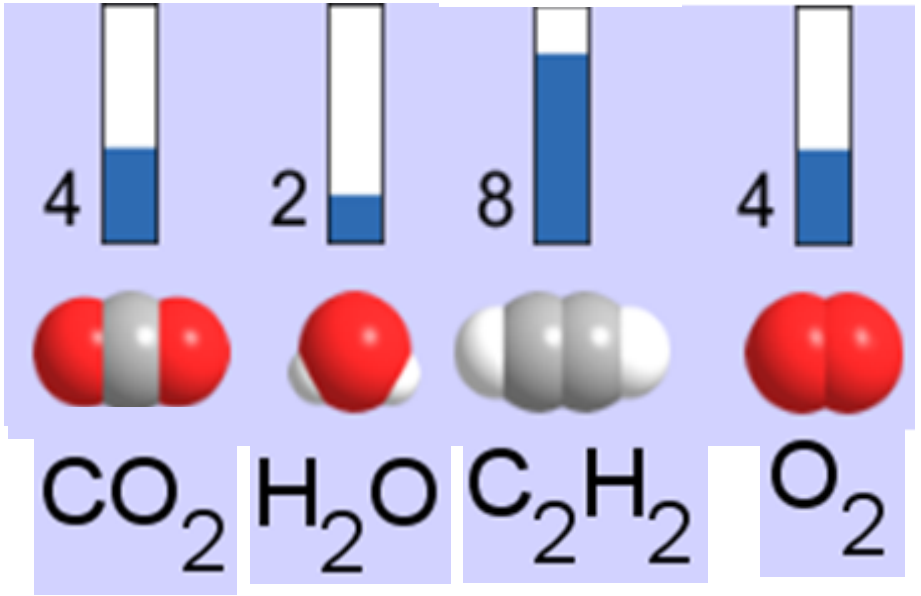

C.10


D. 4


7. **Given the shown amounts for the products and leftovers after a complete reaction, predict the initial reactants.**

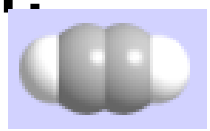
$$2\,C_2H_2 + 5\,O_2 \rightarrow 4\,CO_2 + 2\,H_2O$$





7. What are the amounts before the reaction?

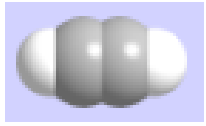
After:

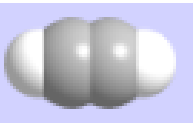


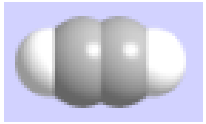

8 C_2H_2 **4 O_2** **4 CO_2**

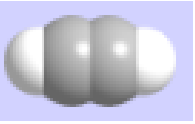
$2\,C_2H_2 + 5\,O_2 \rightarrow 4\,CO_2 + 2\,H_2O$

Before:

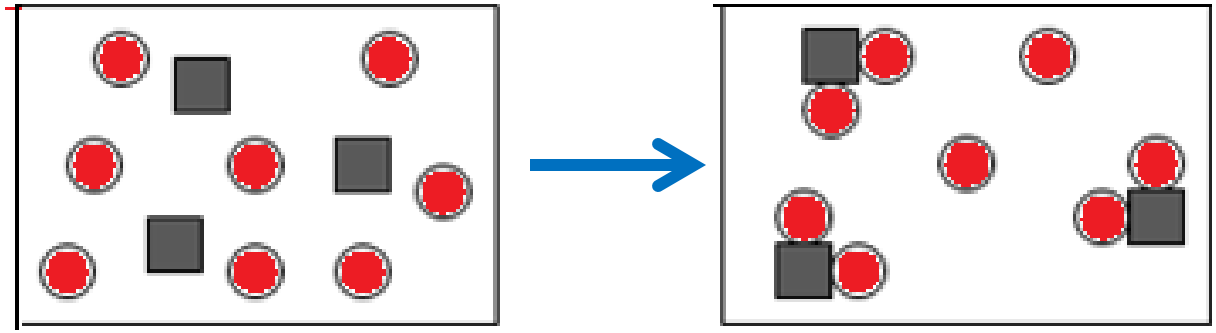
A. 2  1 

B.12  1 

C.10  

D. 8  

8. A mixture of S atoms (■) and O_2 molecules (●) in a closed container is represented by the diagrams:



Which equation best describes this reaction?

A. $3X + 8Y \rightarrow X_3Y_8$

B. $X_3 + Y_8 \rightarrow 3XY_2 + 2Y$

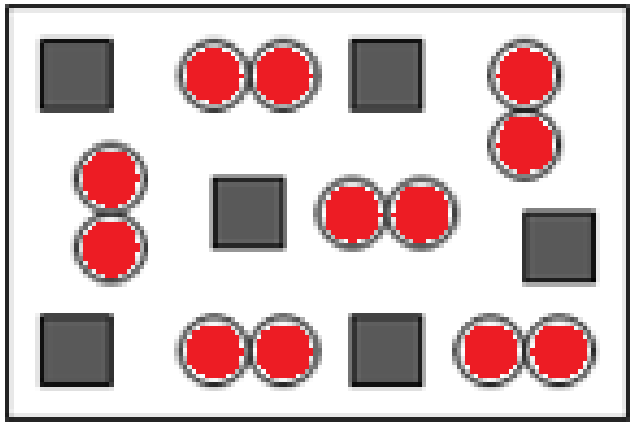
C. $X + 2Y \rightarrow XY_2$

D. $3X + 8Y \rightarrow 3XY_2 + 2Y$

E. $X_3 + Y_8 \rightarrow 3XY_2 + Y_2$

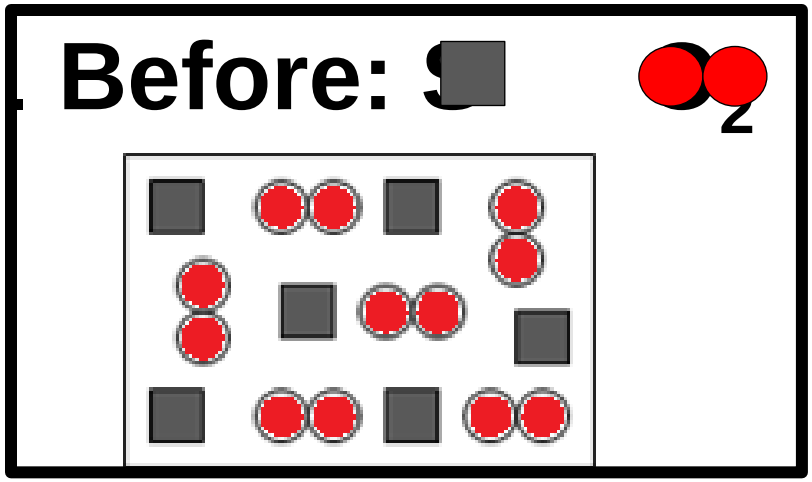
From Lancaster/Perkins activity

9. **An initial mixture of sulfur( ) and oxygen( )is represented:**

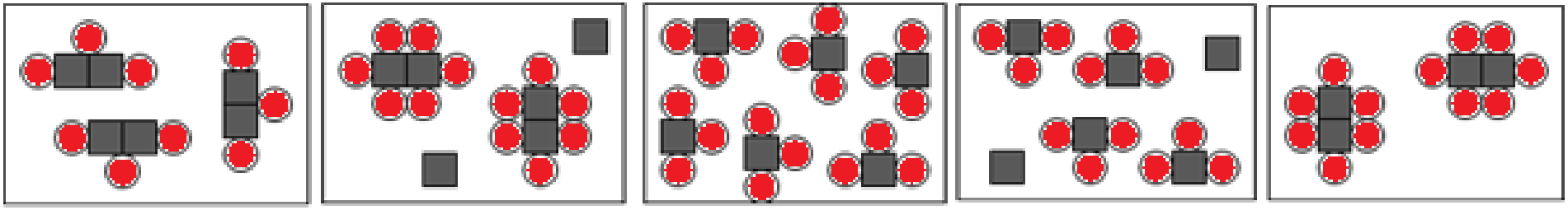


Using this equation: $2S + 3O_2 \rightarrow 2SO_3$, what would the results look like?

From Lancaster/Perkins activity

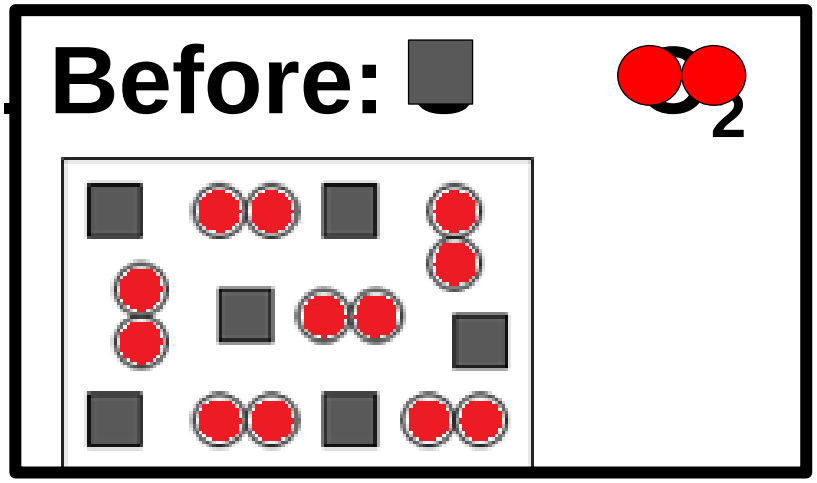
9. **Before:** 

$2S + 3O_2 \rightarrow 2SO_3$

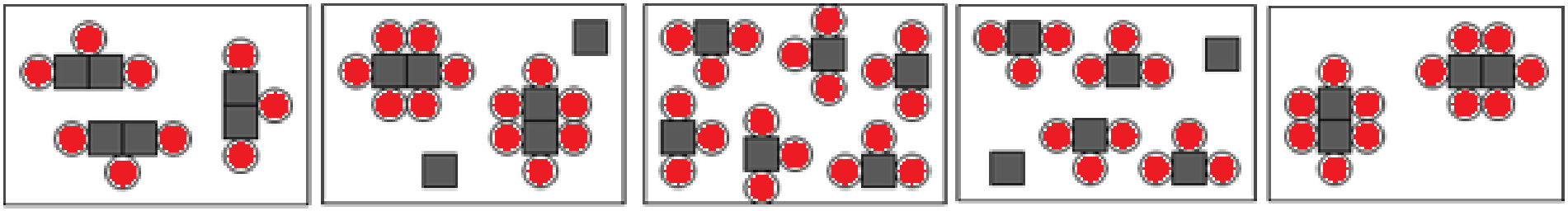


A **B** **C** **D** **E**

From Lancaster/Perkins activity

10. Before: 

$$2S + 3O_2 \rightarrow 2SO_3$$



Which is the limiting reactant?

A. Sulfur

B. Oxygen

C. Neither they are both completely used

From Lancaster/Perkins activity

Build an Atom

Demos for pre-lesson and clicker questions for post-lesson

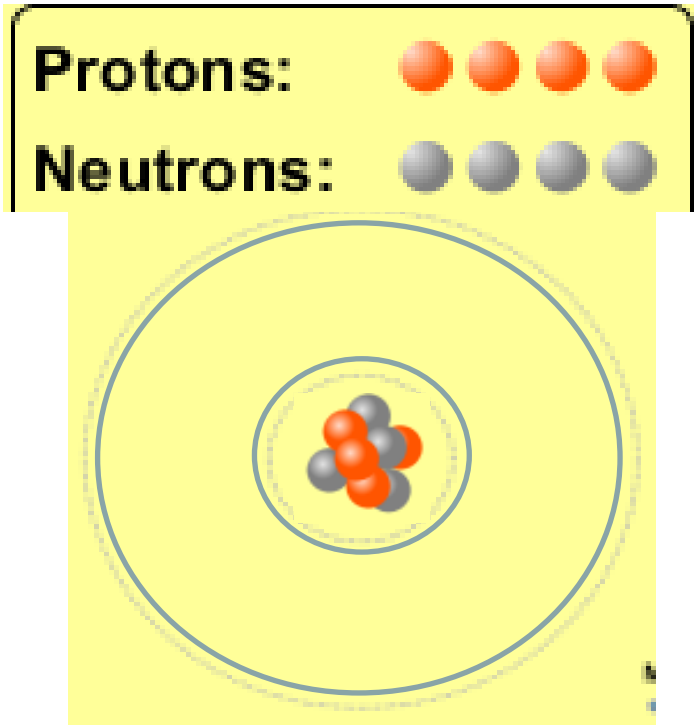
Trish Loeblein 6/14/2011

http://phet.colorado.edu/

Learning Goals- Students will be able to:

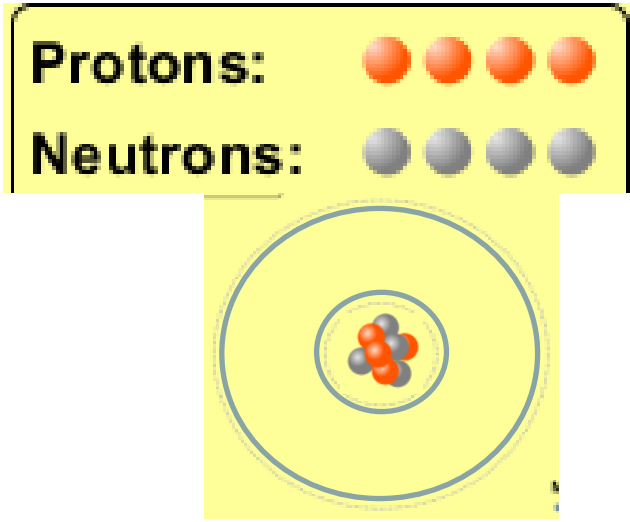
- Make atom models that show stable atoms or ions.
- Use given information about subatomic particles to
- Identify an element and its position on the periodic table
- Draw models of atoms
- Determine if the model is for a neutral atom or an ion.
- Predict how addition or subtraction of a proton, neutron, or electron will change the element, the charge, and the mass of their atom or ion.
- Describe all vocabulary words needed to meet the goals.
- Use a periodic symbol to tell the number of protons, neutrons, and electrons in an atom or ion.
- Draw the symbol for the element as you would see on the periodic table

1. What can you make with 4 protons and 4 neutrons?



A. Oxygen atom
B. Oxygen ion
C. Beryllium atom
D. Beryllium ion
E. 2 of these

2. Would you predict that 4 protons and 4 neutrons will make a stable nucleus?

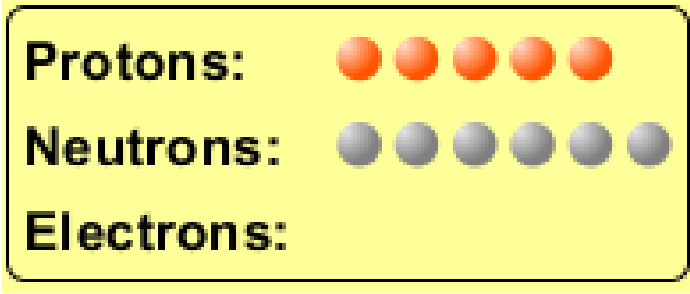


A. No, because the net charge is high

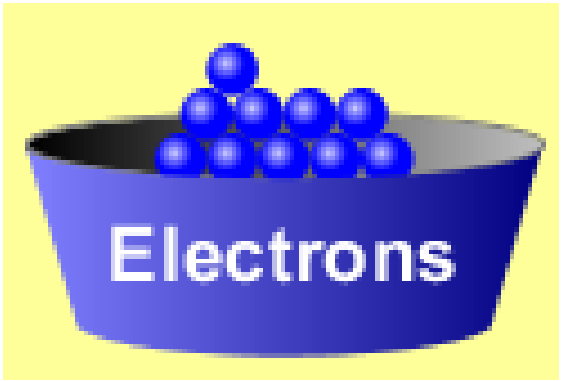
B. No, because there should always be more protons than neutrons

C. Yes, because the number of protons and neutrons are about equal

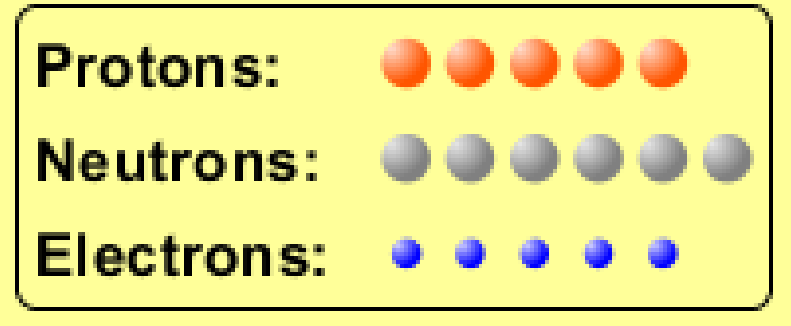
3. If you have 5 protons & 6 neutrons, how many electrons would you add to make a neutral atom ?

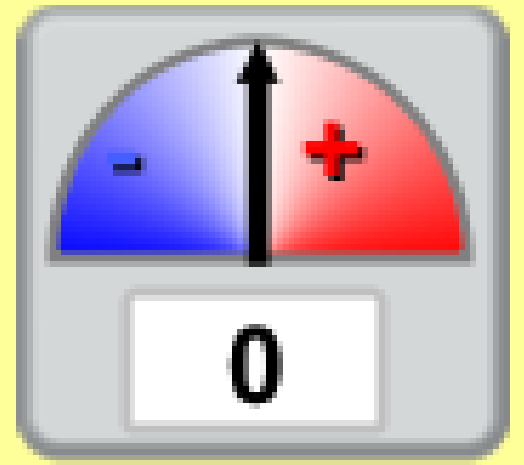


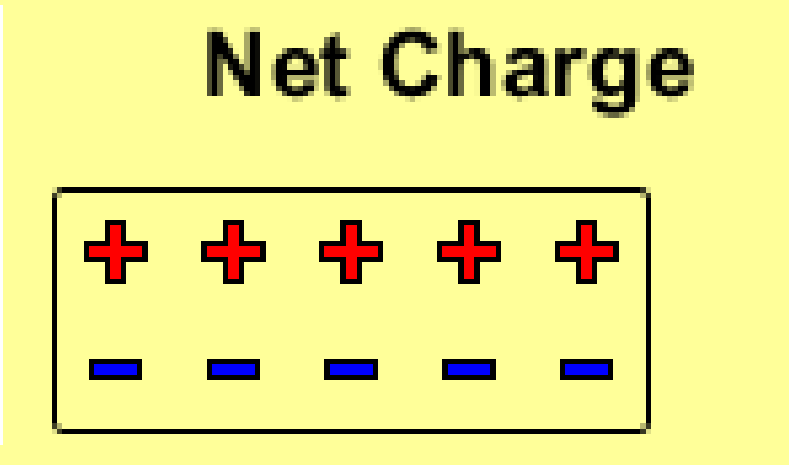
A. 5 electrons
B. 6 electrons
C. 11 electrons



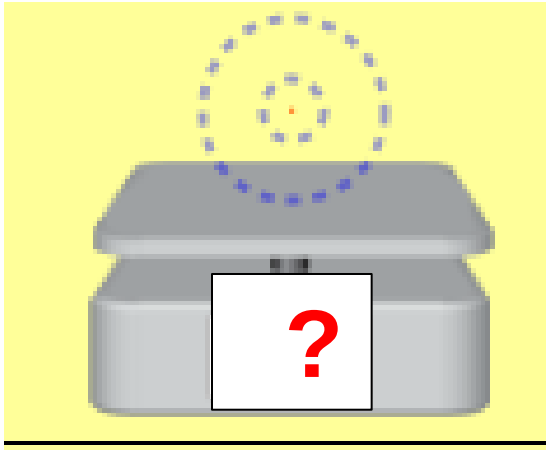
3. Reasoning: Neutrons don't matter because they have zero charge; need equal number of protons and electrons





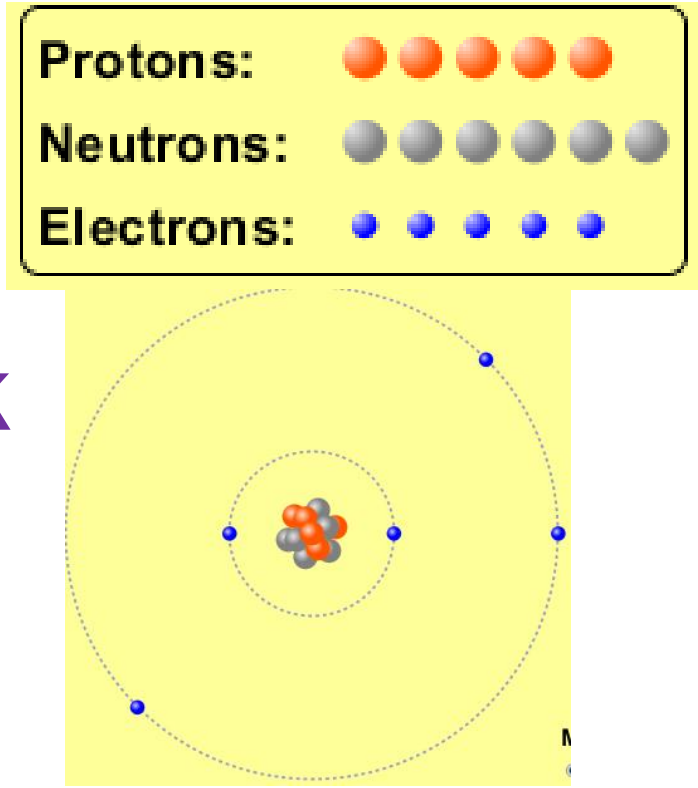


4. What is mass for an atom with 8 protons, 9 neutrons and 8 electrons?



A. Zero
B. 8
C. 16
D. 17
E. 25

5. If you have 5 protons, 6 neutrons, & 5 electrons, what would the symbol look like?



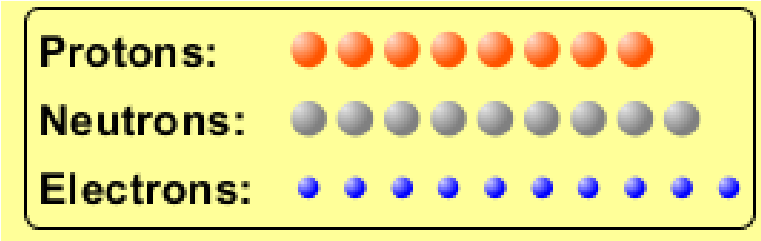
A. $^{11}_{5}B^{0}$

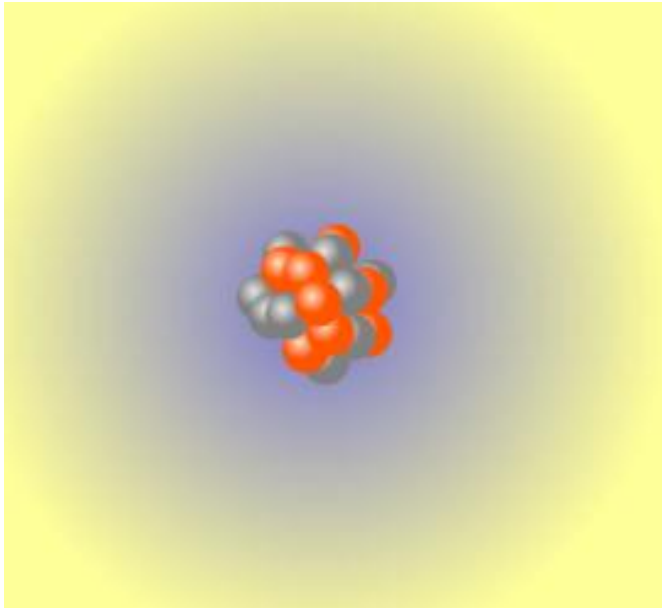
B. $^{11}_{5}B^{+1}$

C. $^{11}_{6}C^{+1}$

D. $^{11}_{6}C^{-1}$

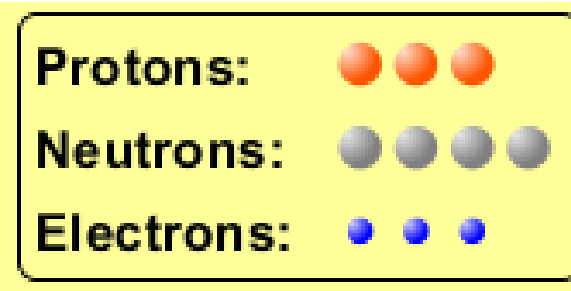
6. If you have 8 protons, 9 neutrons, 10 electrons, what would the atom or ion be?

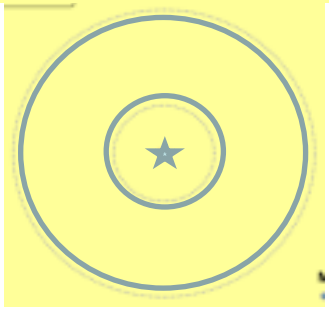




A. Zero, it's an atom
B. +2 ion
C. +1 ion
D. -1 ion
E. -2 ion

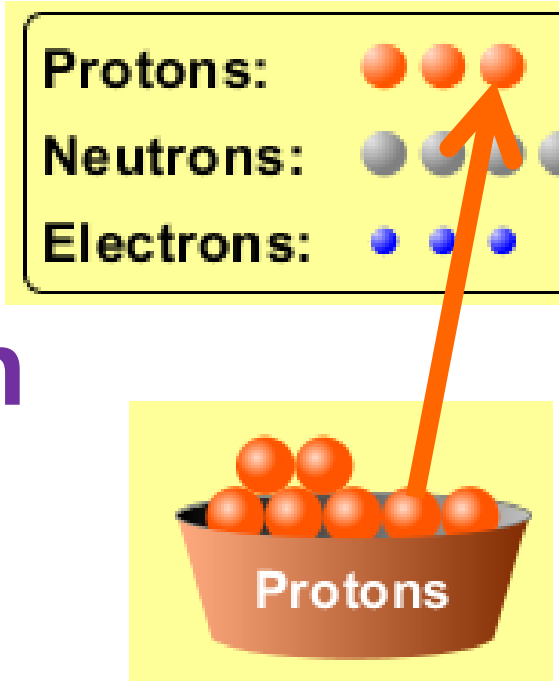
7. If you have 3 protons, 4 neutrons, & 3 electrons what would the model look like?





A. 3 red & 3 blue in center; 4 grey on rings
B. 3 red & 4 grey in center; 3 blue on rings
C. 3 blue & 4 grey in center; 3 red on rings

8. If a particle has 3 protons, 4 neutrons, & 3 electrons, then a proton is added what would the symbol be?



A	B	C	D
$^{7}_{3}Li^{0}$	$^{7}_{4}Li^{0}$	$^{8}_{4}Li^{+1}$	$^{8}_{4}Be^{+1}$

Build a Molecule **activity**

by Trish Loeblein
http://phet.colorado.edu/

Learning Goals: Students will be able to:

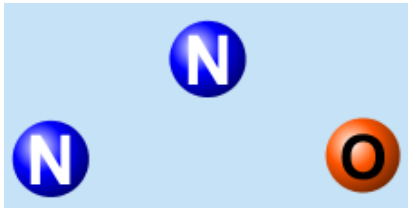
Review:

- Describe the differences between an atom and a molecule.
- Describe what the subscripts and coefficients indicate in chemistry notation.
- Use proper chemistry nomenclature.

New:

- Construct simple molecules from atoms.
- Write rules for how atoms are arranged given formulas for some common molecules
- Draw, name, and write formulas for some common molecules.

1. **Which picture best displays atoms?**

A. 

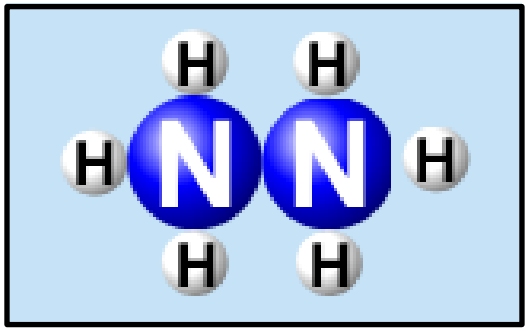
B. 

C. Both would be described as "atoms"

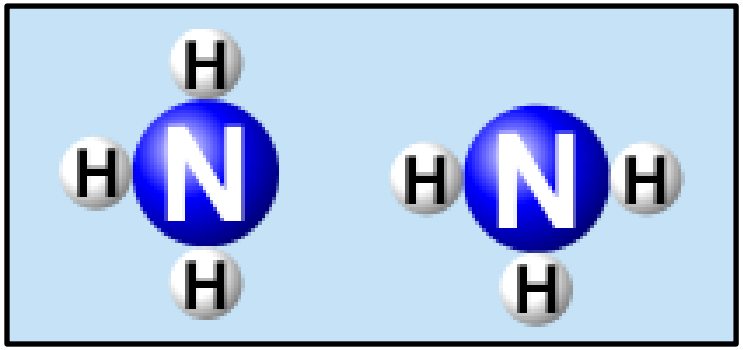
D. Both are better described as molecules

2. **Which picture displays $2NH_3$?**

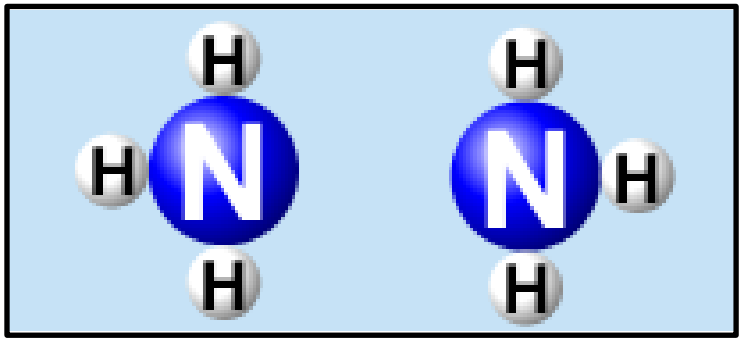
A.



B.

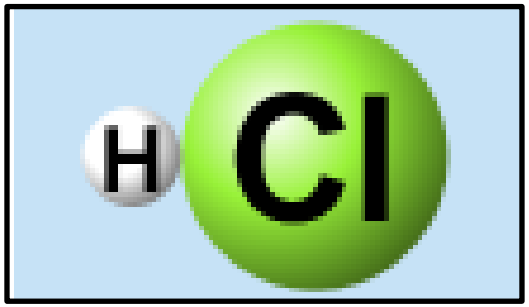


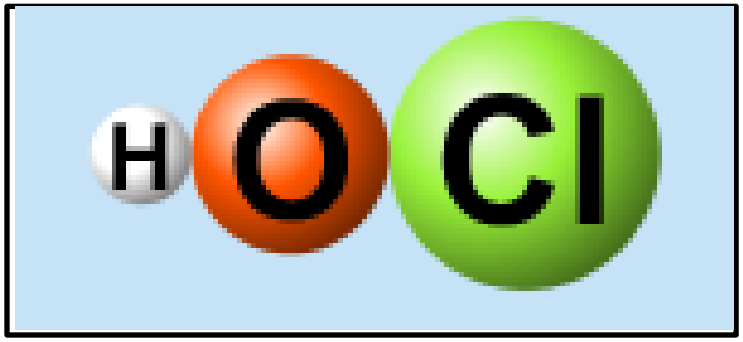
C.

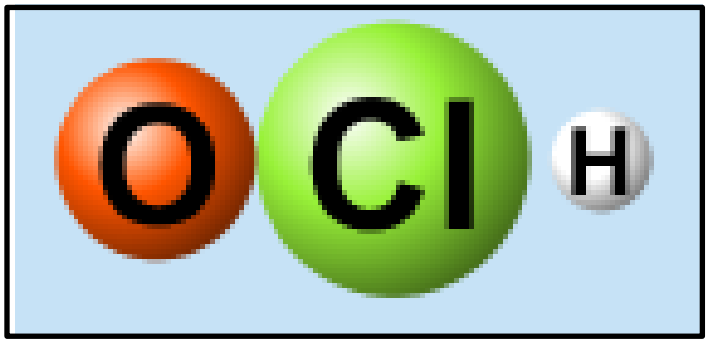


D. **Two are correct**

3. **Which could be hydrochloric acid?**

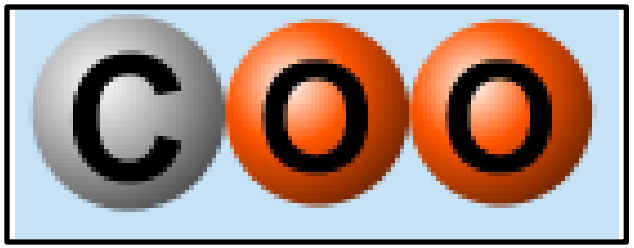
A. 

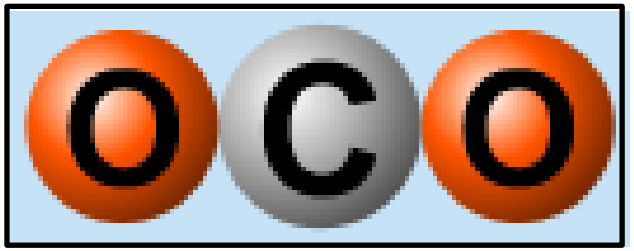
B. 

C. 

D. Two are correct

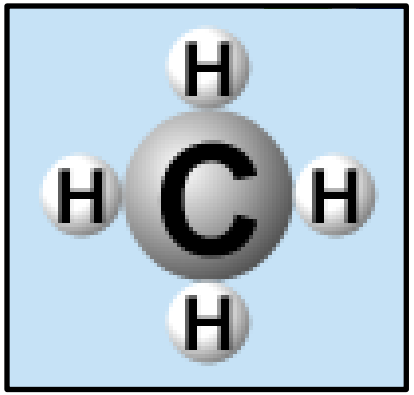
4. **Which could be CO_2?**

A. 

B. 

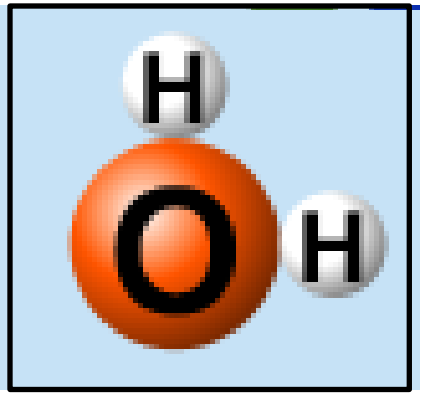
c. Both are stable molecules

5. **What is the name of this molecule?**



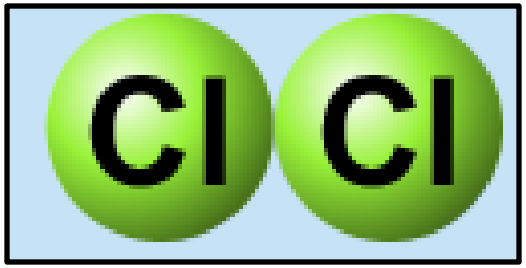
A. Methane
B. Tetrahydrogen carbide
C. Ammonia
D. Water

6. **What is the name of this molecule?**



A. Dihydrogen oxide
B. Carbon dioxide
C. Ammonia
D. Water

7. **What is the name of this molecule?**



A. Dichloride
B. Dichlorine
C. Chlorine
D. This is not a stable molecule

Acid Base Solutions: **Strength and Concentration**

by Trish Loeblein July 2011

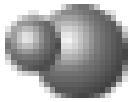
Learning goals: Students will be able to

1. **Generate or interpret molecular representations (words and/or pictures) for acid or base solutions**
2. **Provide or use representations of the relative amounts of particles in acid or base solutions to estimate strength and/or concentration**
3. **Use common tools (pH meter, conductivity, pH paper) of acid or base solutions to estimate strength and/or concentration**

Some materials adapted from an activity by Lancaster /Langdon

Icons for Acid Base Solutions

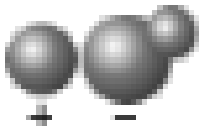
H_2O



HA

A^-

H_3O^+

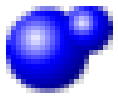


MOH

M^+

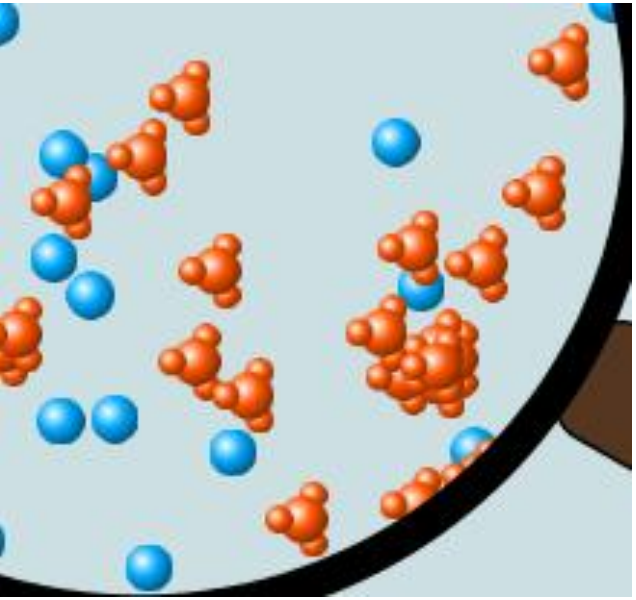
B

BH^+

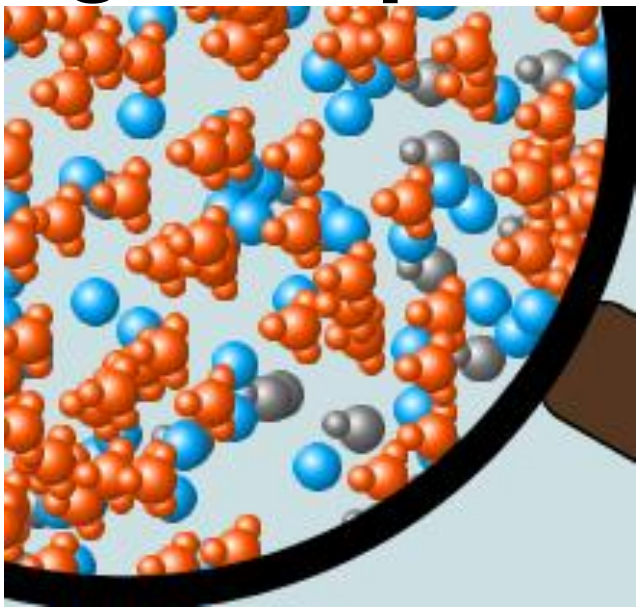


OH^-

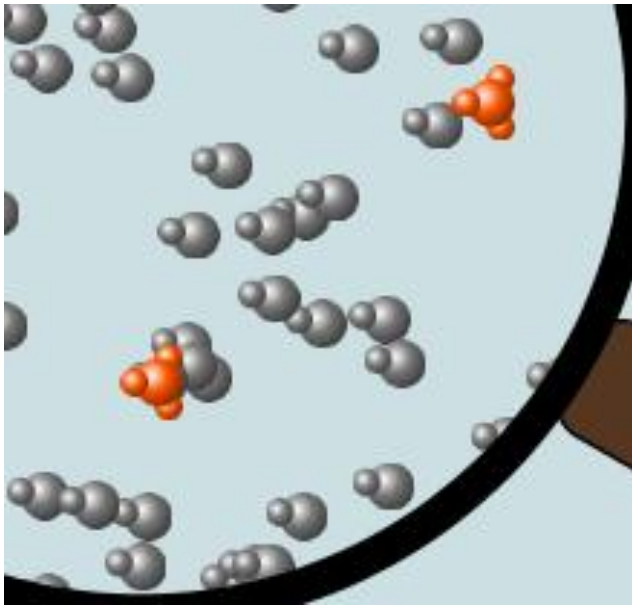
1.Order the solutions from lowest to highest pH.



X



Y



Z

A. X<Y<Z

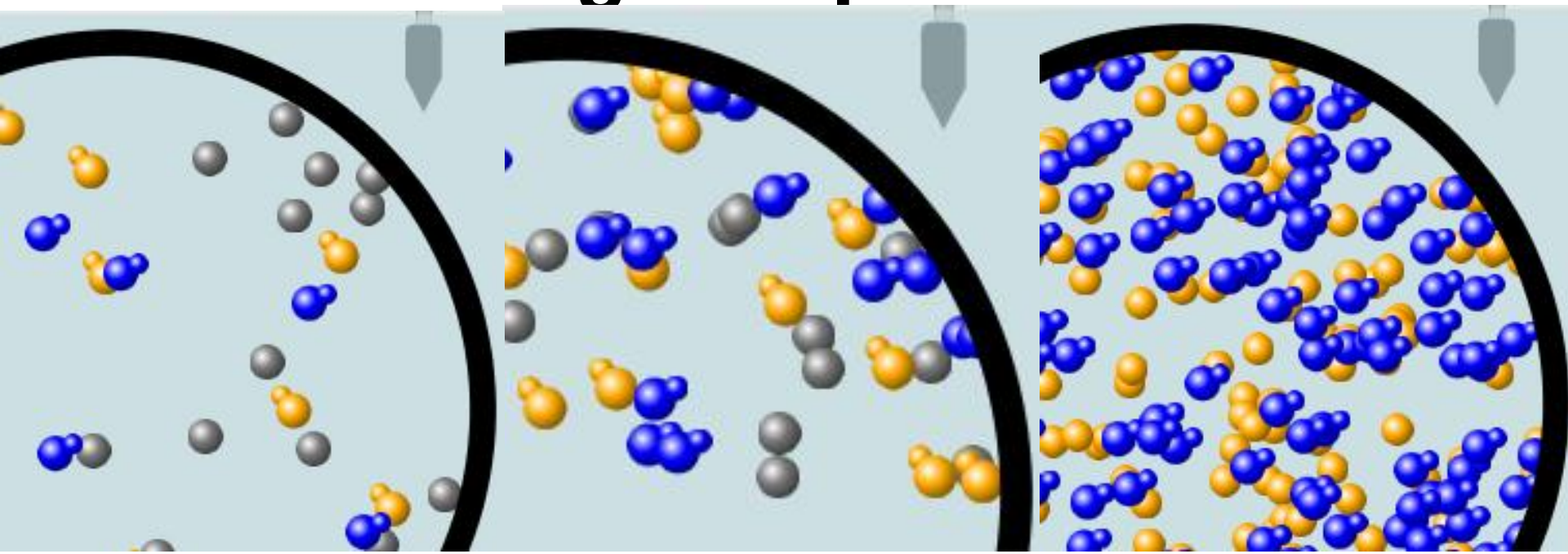
B. Y<X<Z

C. Z<Y<X

D. Z<X<Y

E. Y<Z<X

2.Order the solutions from lowest to highest pH.



X

Y

Z

A. X<Y<Z

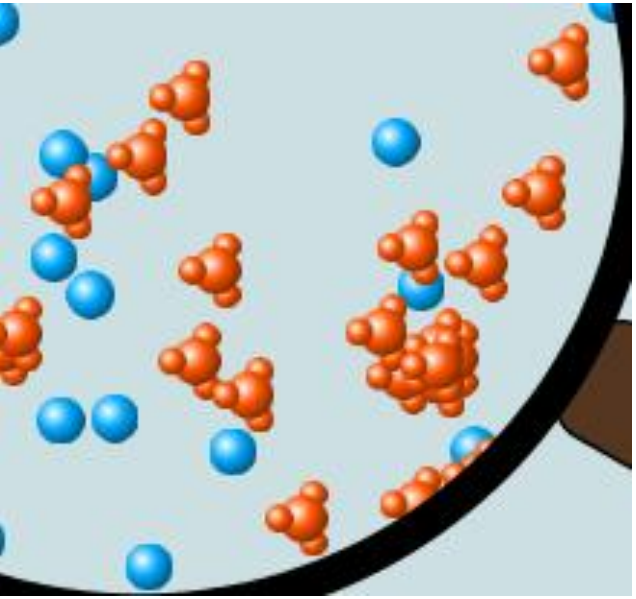
B. Y<X<Z

C. Z<Y<X

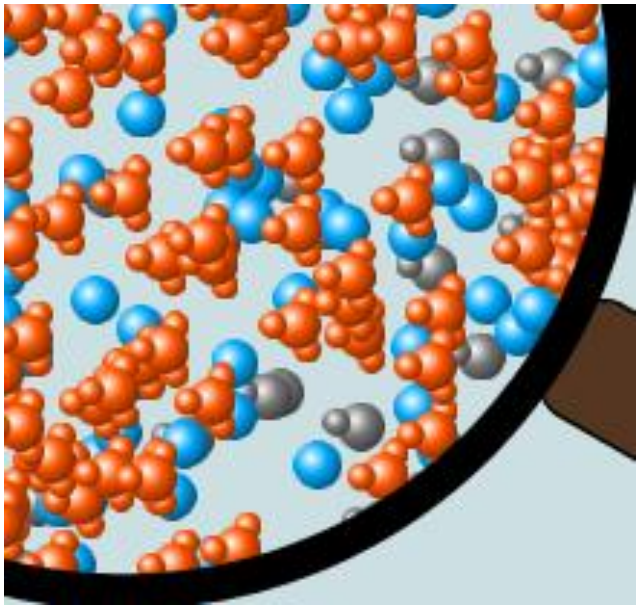
D. Z<X<Y

E. Y<Z<X

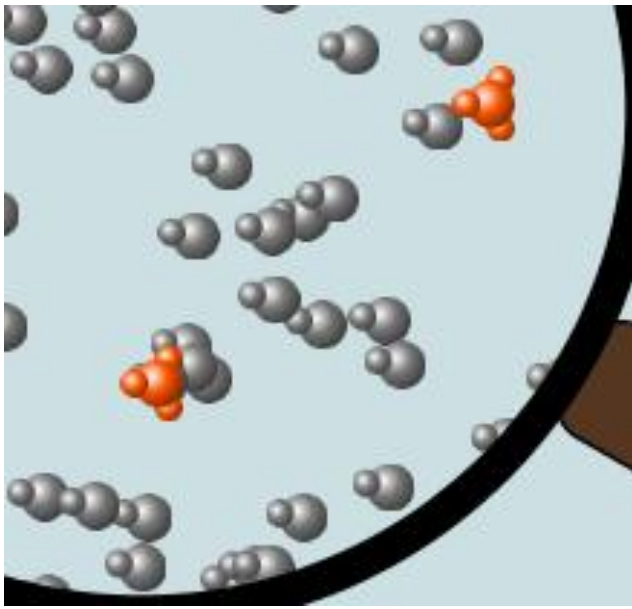
3. Which image is from a strong acid?



X



Y

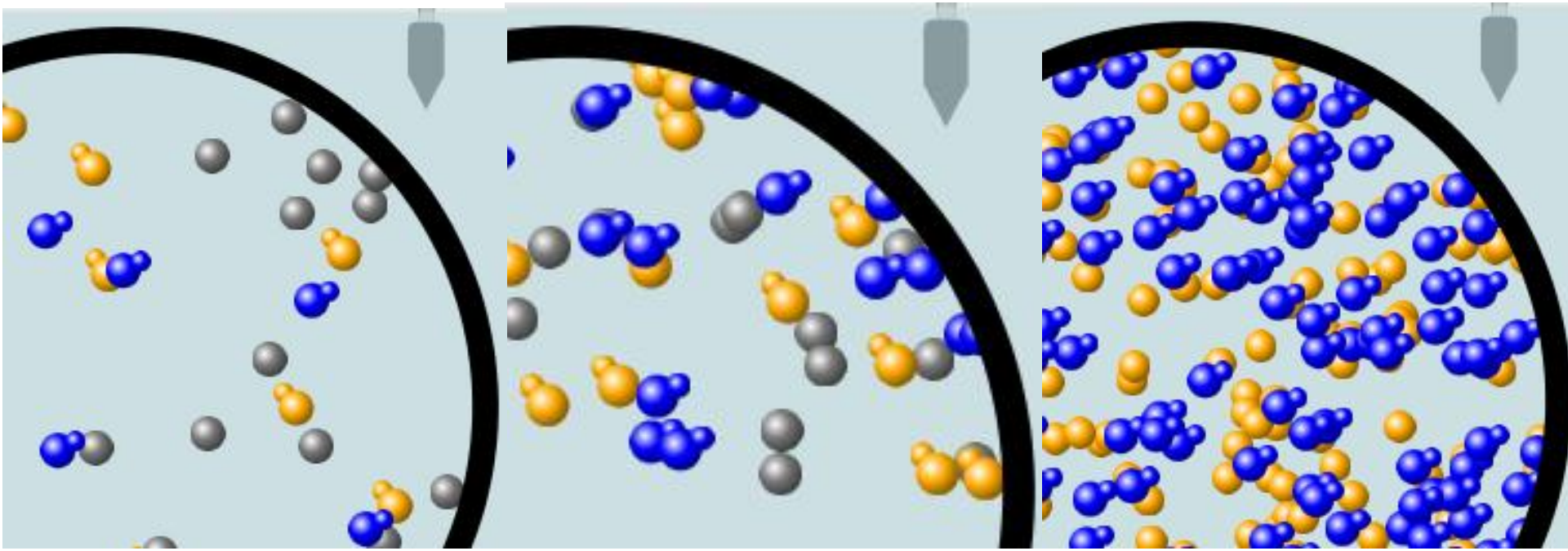


Z

A. X **B. Y** **C. Z**

D. more than one **E. none**

4. Which image is from a weak base?

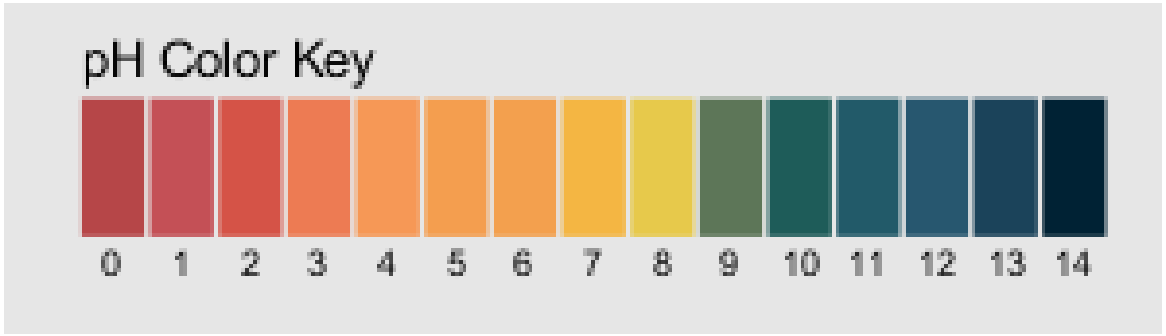


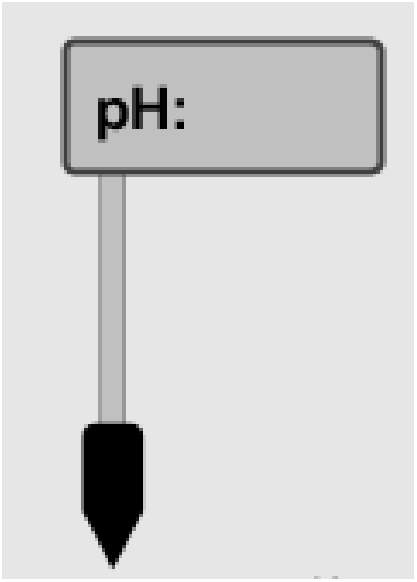
X Y Z

A. X B. Y C. Z

D. more than one E. none

5. Strong acids have lower pH than weak acids.





A. Always True

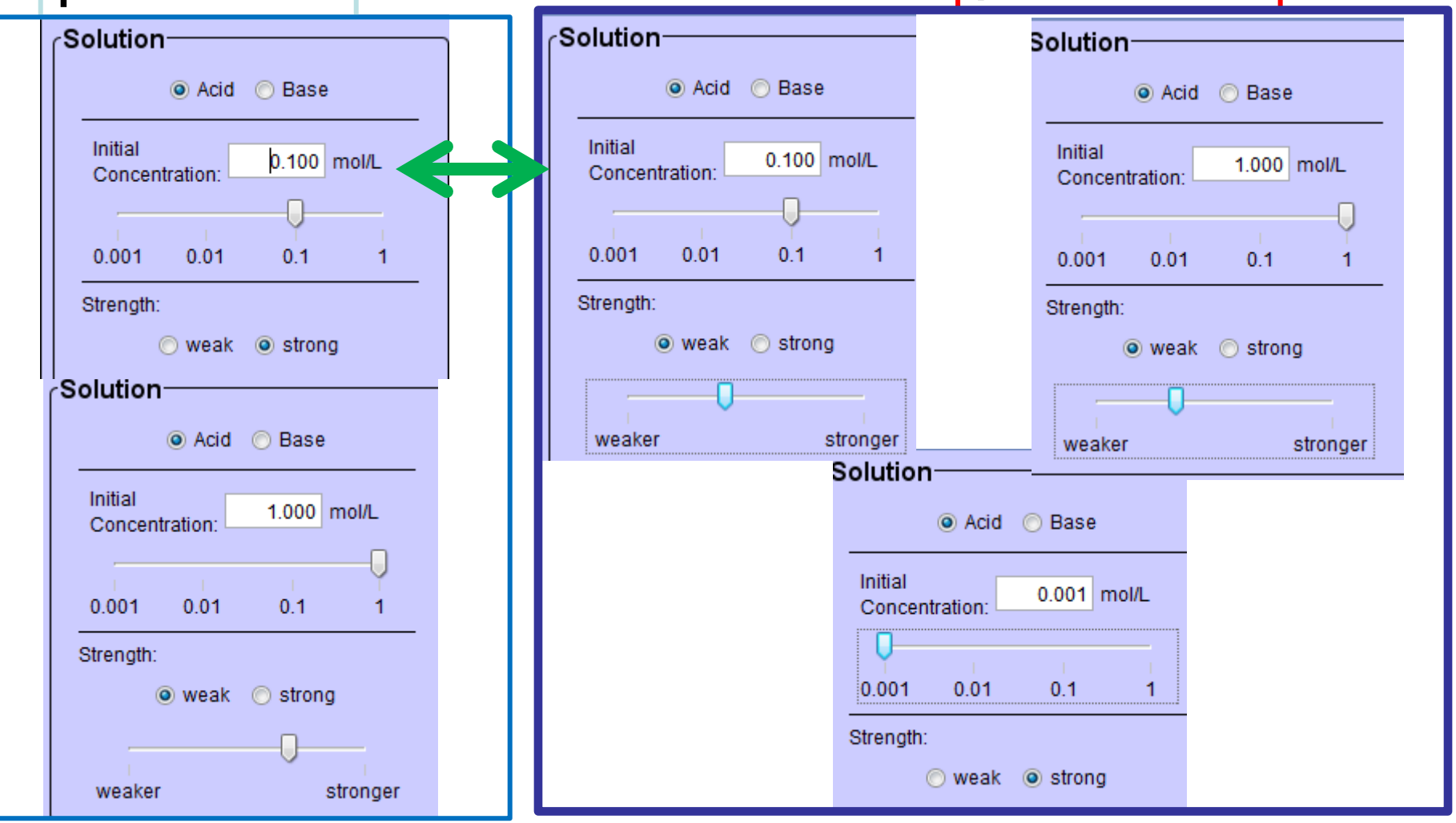
B. Always False

C. Sometimes True

5. Strong acids have lower pH than weak acids?

pH = 1

pH = 3



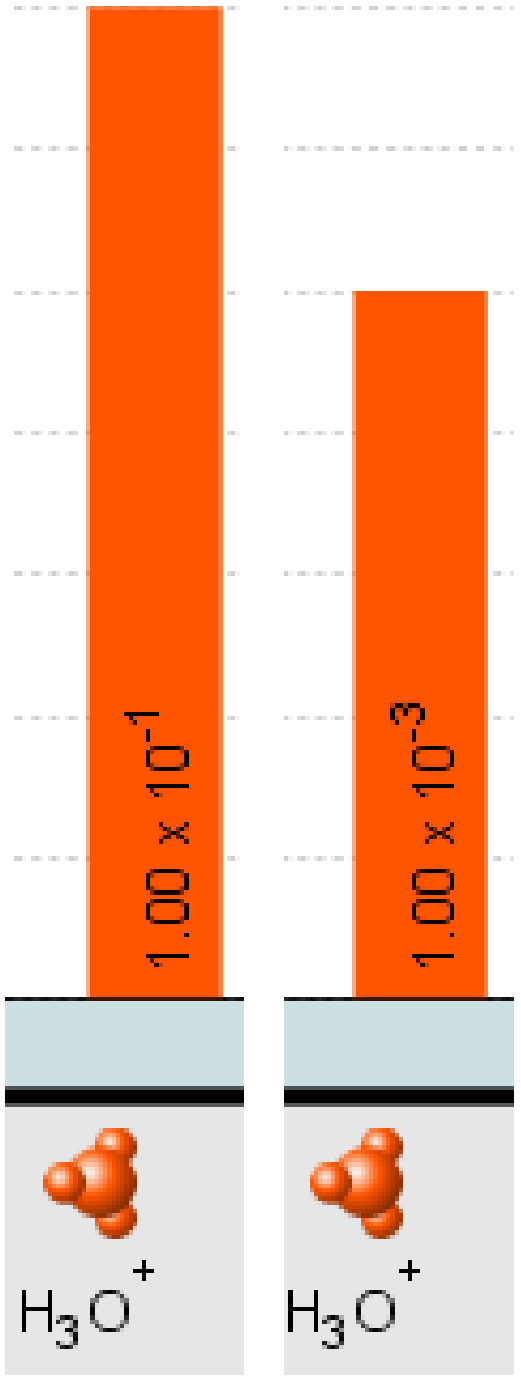
Use pH meter to see that if the acids are the same concentration, then the statement is true, but there are other possibilities

7. A solution with $[H_3O^+]$ = .1 M contains a <u>stronger</u> acid than a solution $[H_3O^+]$ = .001 M.

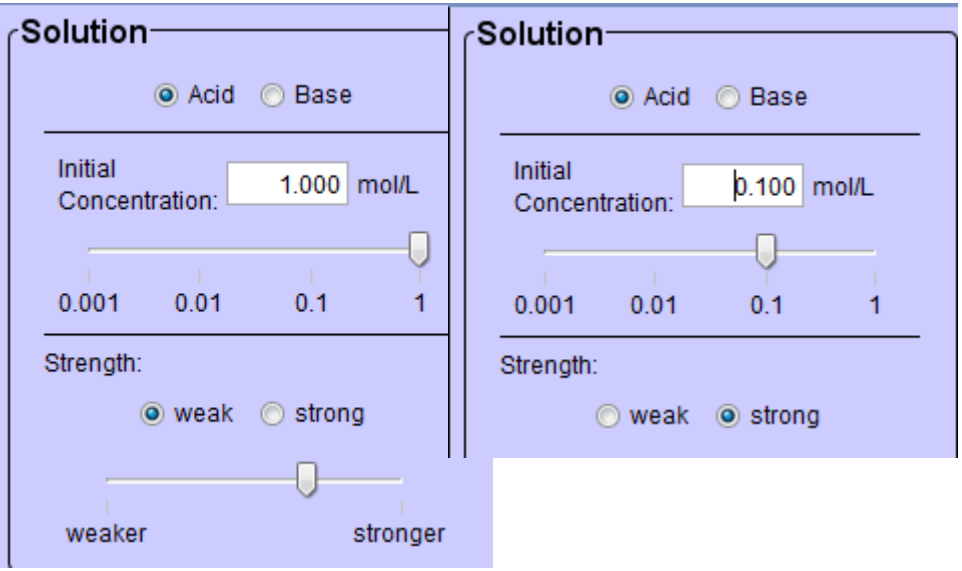
A. Always True

B. Always False

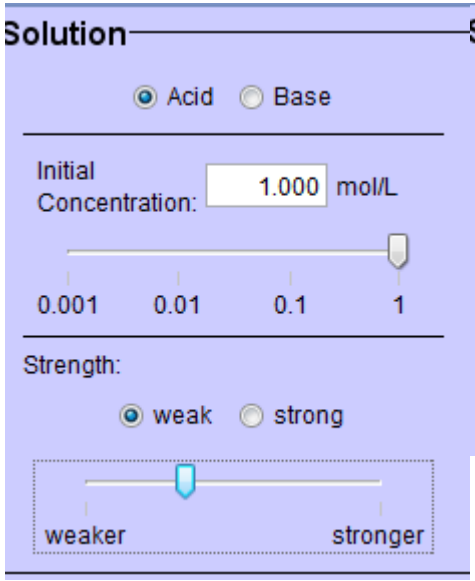
C. Sometimes True

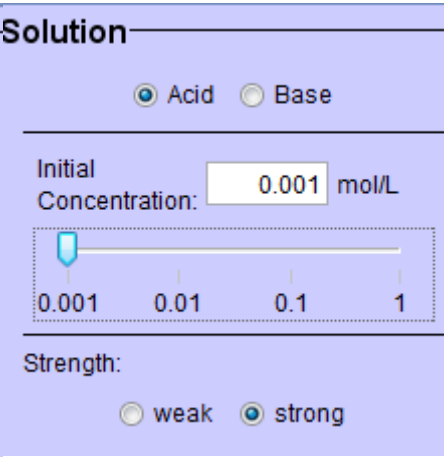


8. A solution with $[H_3O^+]$ = .1 M contains a <u>stronger</u> acid than a solution $[H_3O^+]$ = .001 M?



.1 M Hydronium





.001 M Hydronium

Use the Equilibrium concentration View to see that if the acid is weak, then the statement is true, but if the acid is strong, concentration matters.

9. **What ALWAYS distinguishes a weak acid from a strong acid?**

A. **A weak acid doesn't react much in water; strong acids completely react.**

B. **A weak acid is more dilute than a strong acid.**

C. **A weak acid has a higher pH than a strong acid.**

D. **Statements a and c are both characteristics that distinguish weak acids from strong acids.**

E. **Statements a, b, and c are all characteristics that distinguish weak acids from strong acids.**

10. **What ALWAYS distinguishes a weak base from a strong base?**

A. **A weak base doesn't react much in water; strong bases completely react.**

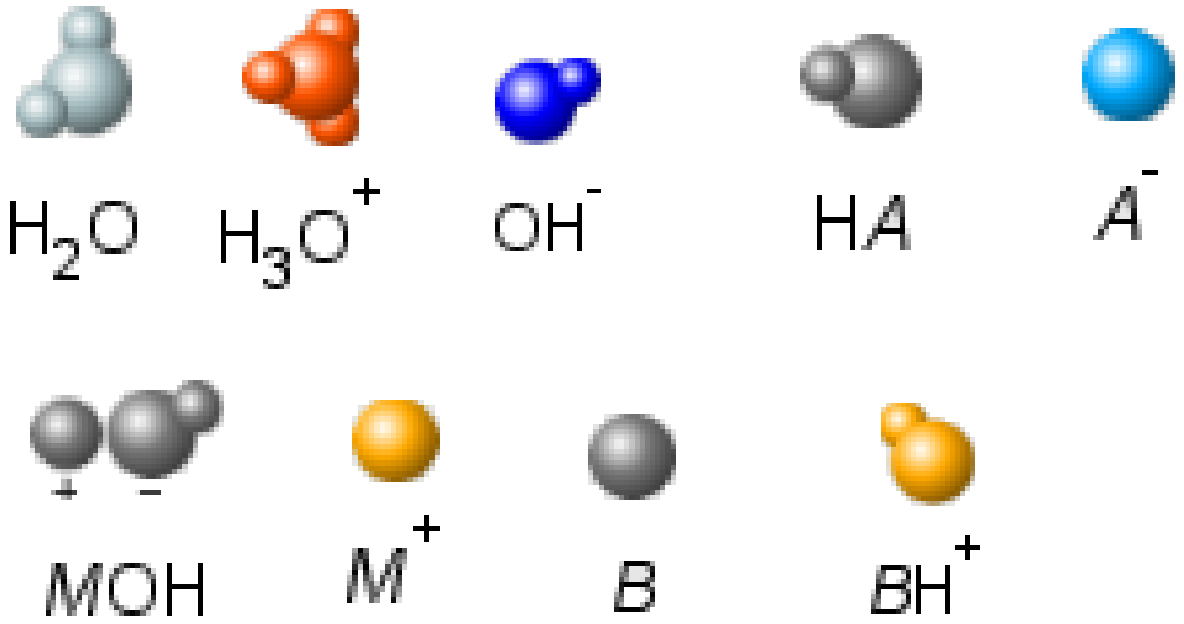
B. **A weak base is more dilute than a strong base.**

C. **A weak base has higher pH than a strong base.**

D. **Statements a and c are both characteristics that distinguish weak bases from strong bases.**

E. **Statements a, b, and c are all characteristics that distinguish weak bases from strong bases.**

Icons for Acid Base Solutions



Use these icons to write reactions for strong and weak acids and then for strong and weak bases.

Sugar and Salt Solutions 1

Learning Goals: Students will be able to:

- **Identify if a compound is a salt or sugar by macroscopic observations or microscopic representations.**
- **Explain how using combinations of solutes changes solution characteristics or not.**
- **Use observations to explain ways concentration of a solute can change.**
- **Describe ways the formula, macroscopic observations, or microscopic representations of a compound indicates if the bonding is ionic or covalent.**

by Trish Loeblein updated October 2011 phet.colorado.edu

1. Which would you predict to be a salt?

A. CO_2

B. $CaCl_2$

C. $C_{12}H_{22}O_{11}$

D. HCl

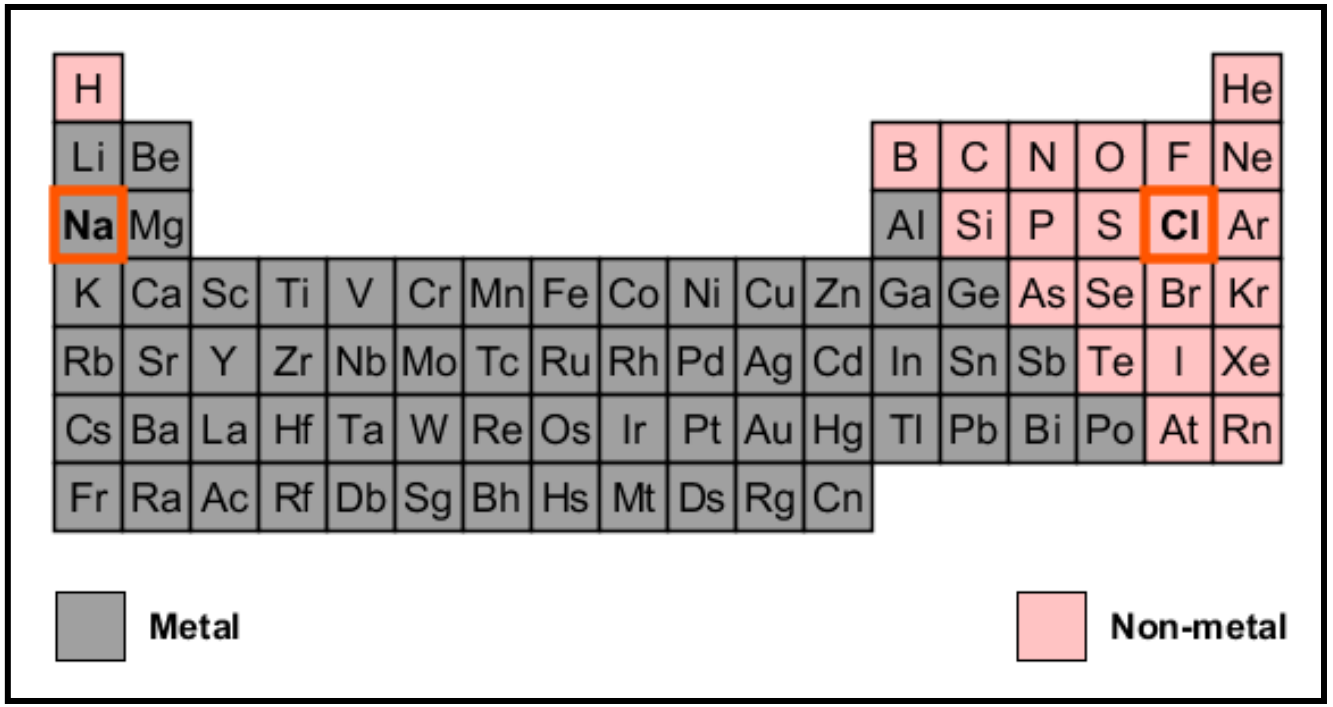
1. Ans Which would you predict to be a salt?

A. CO_2

B. $CaCl_2$

C. $C_{12}H_{22}O_{11}$

D. HCl



A metal combined with a non-metal make a "salt".

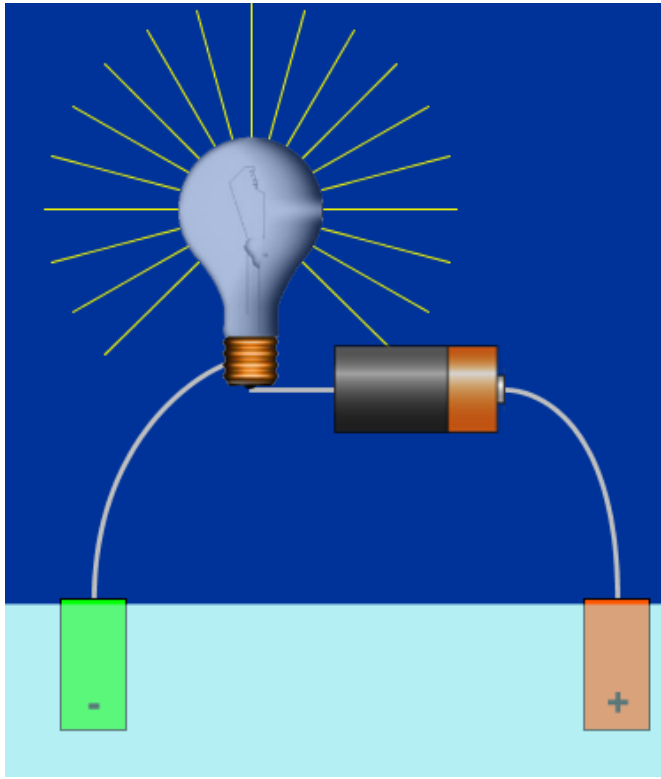
2. If a compound conducts electricity when in solution with water, you might categorize the compound as a

A. salt

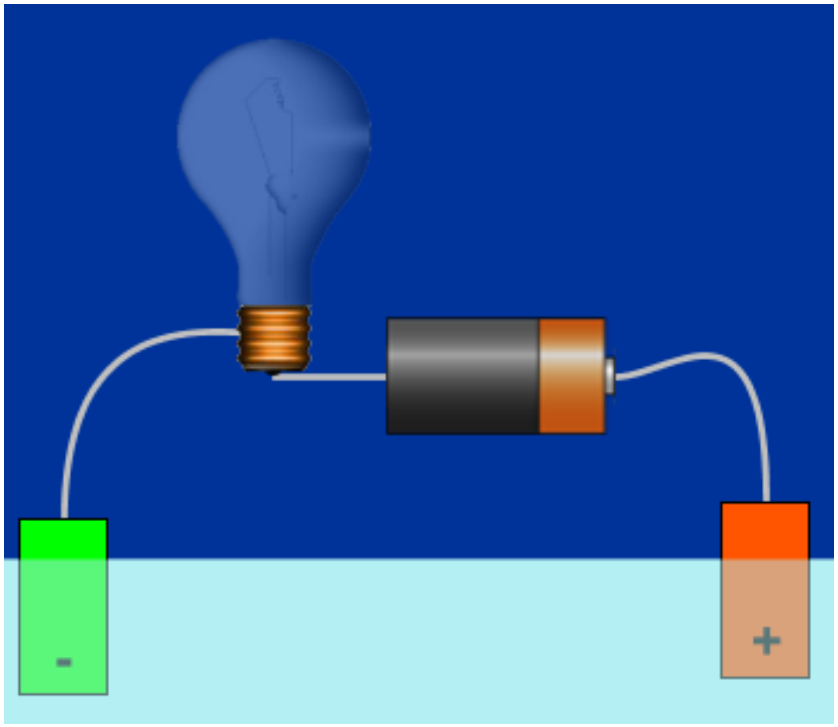
B. sugar

C. Both conduct

D. Neither conduct



3. Which would not conduct electricity very well in solution with pure water?



A. O_2

B. $CaCl_2$

C. $C_{12}H_{22}O_{11}$

D. HCl

E. More than one of these

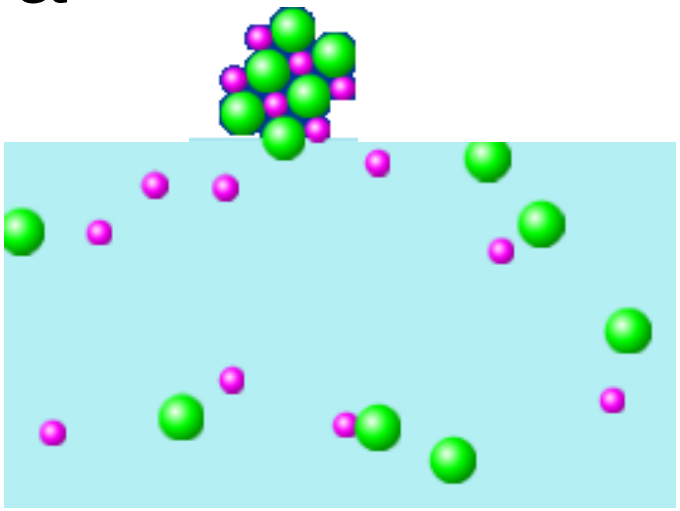
3ans. Which would not conduct electricity very well in solution with pure water?

A. O_2
B. $CaCl_2$
C. $C_{12}H_{22}O_{11}$
D. HCl
E. More than one of these

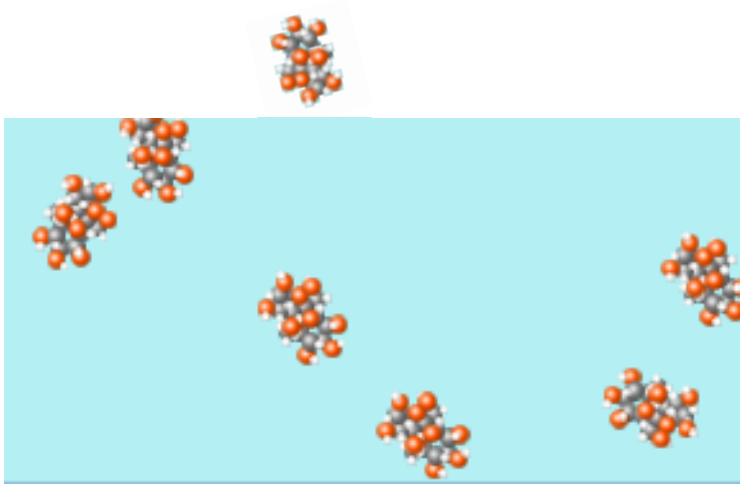
Non-metals combined with each other don't break into ions in solution. Ions are needed to conduct. Acids are an exception (compounds that begin with H); usually they break into ions.

4. If the microscopic view of a compound in water looks like the picture on the left (I.), you might categorize the compound as a

I.

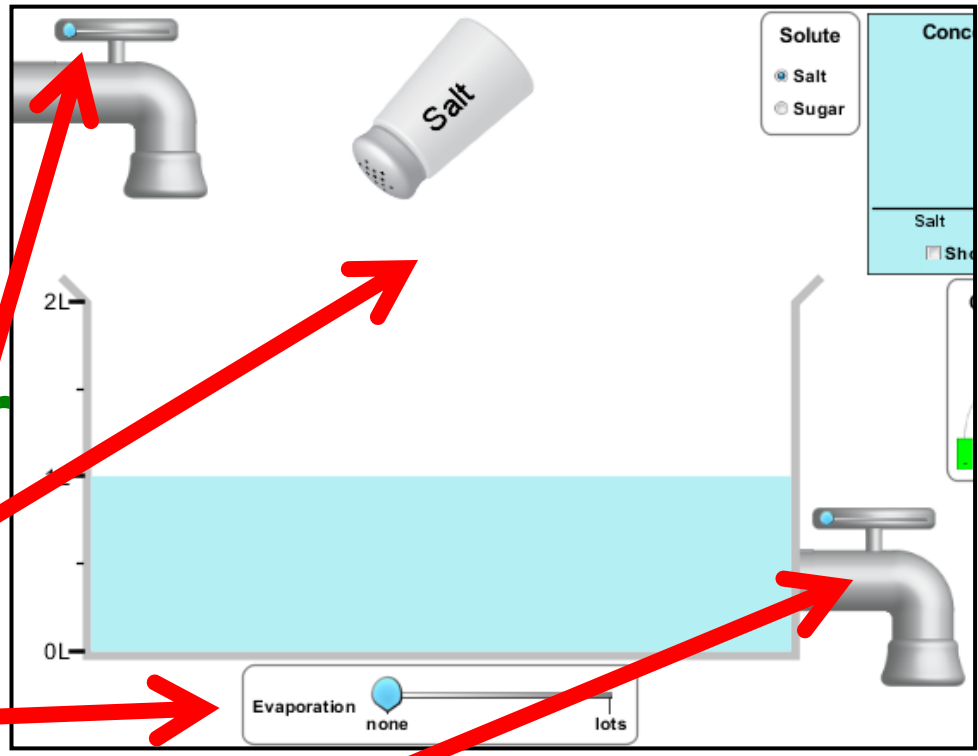


II.



A. Salt **B. Sugar** **C. Neither**

5. To increase the concentration of a solution, you could



A. Add more water

B. Add more salt

C. Evaporate

D. Drain out solution

E. More than one of these

6. Which would you predict to be ionic?

A. **NO**

B. **MgF_2**

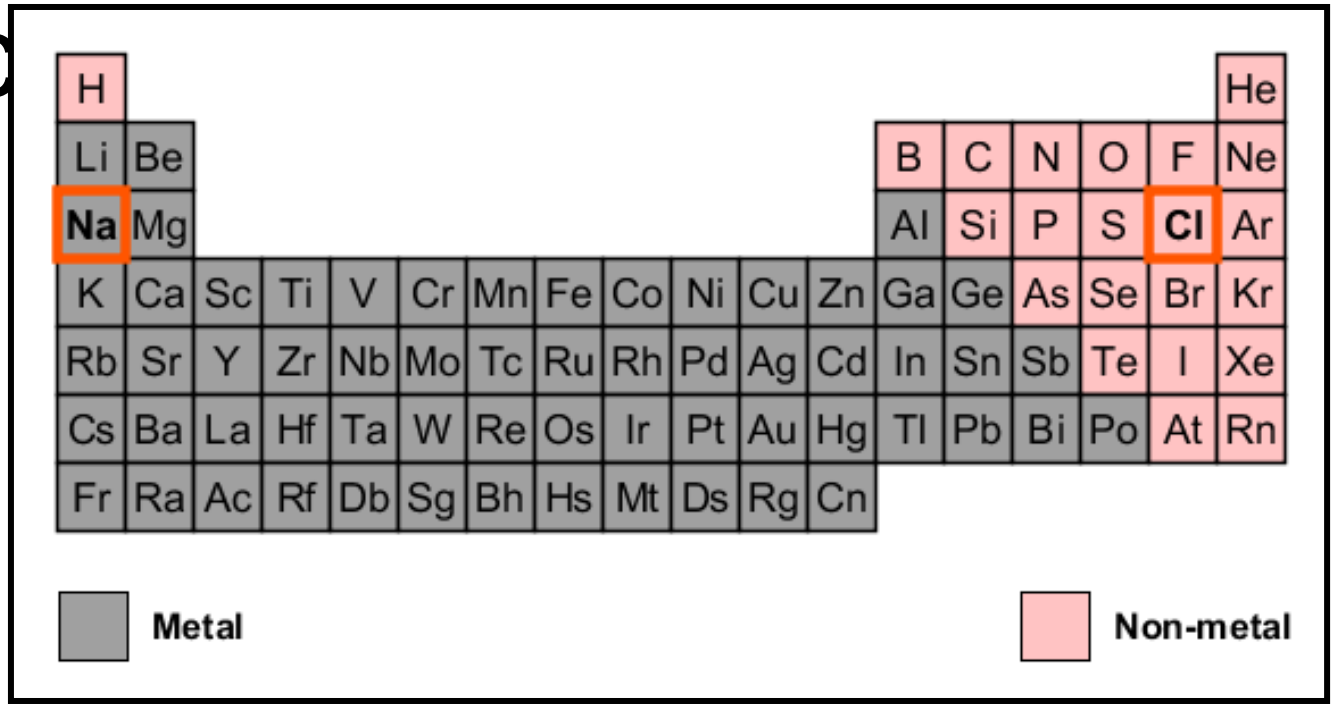
C. **Al_2O_3**

D. **I_2**

E. **More than one of these**

6ans. Which would you predict to be ionic

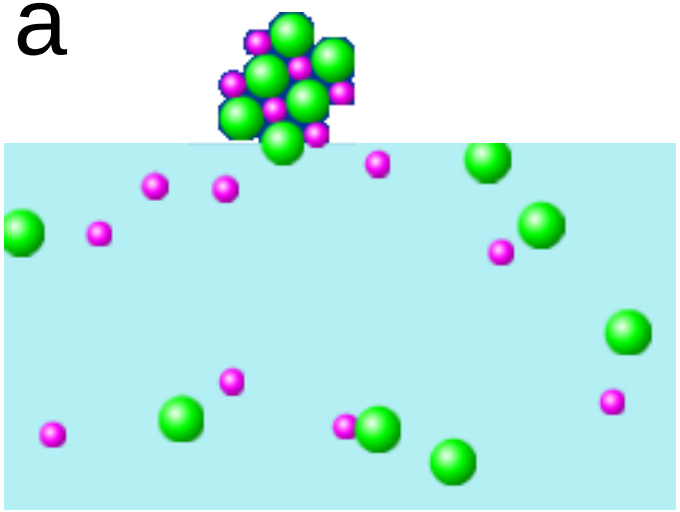
A. **NO**
B. **MgF_2**
C. **Al_2O_3**
D. **I_2**
E. **More than one of these**



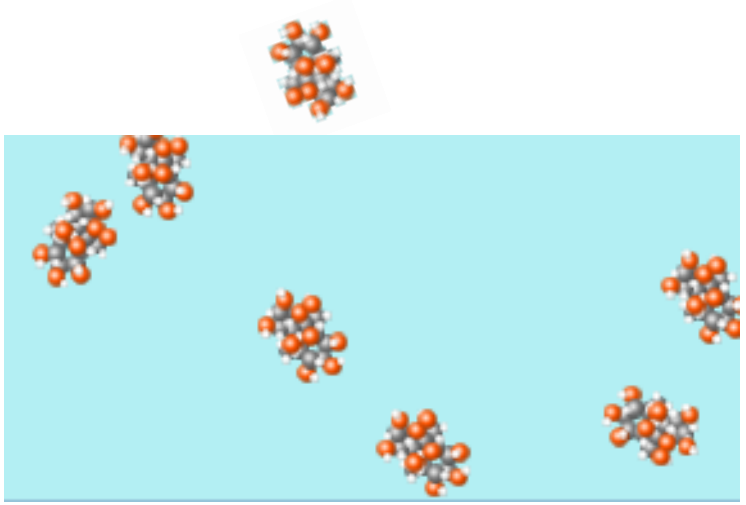
A metal combined with a non-metal make an "ionic compound".

7. If the microscopic view of a compound in water looks like the picture on the left (I.), you might categorize the compound as a

I.



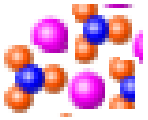
II.

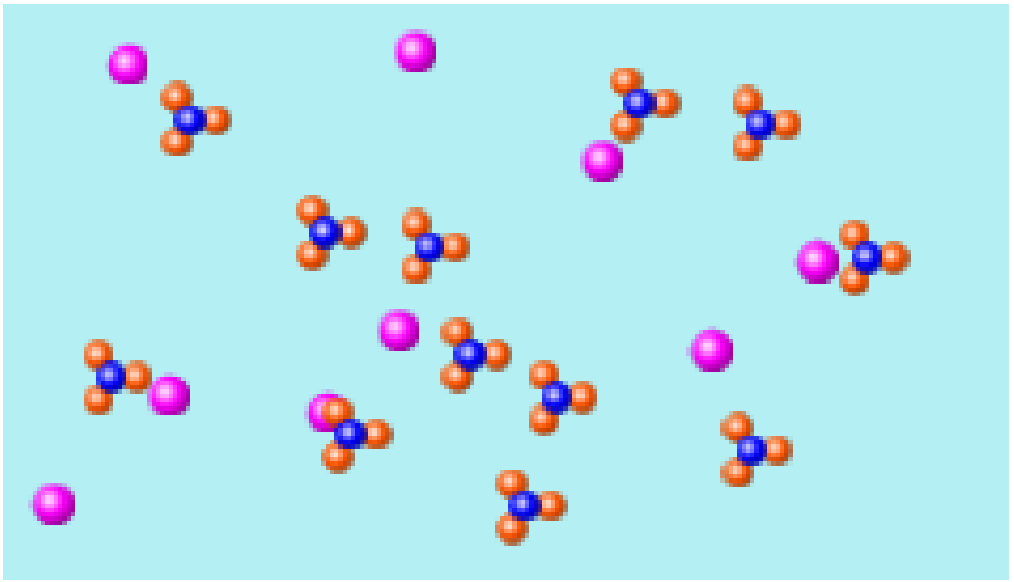


A. Ionic B. Covalent C. Neither

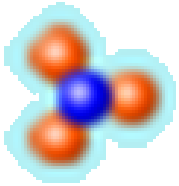
7b What is the compound on the right (II.)?

8. If the microscopic view of a compound in water looks like the picture, you might categorize the compound as

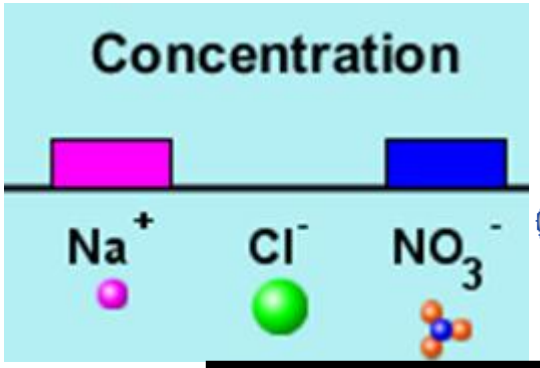


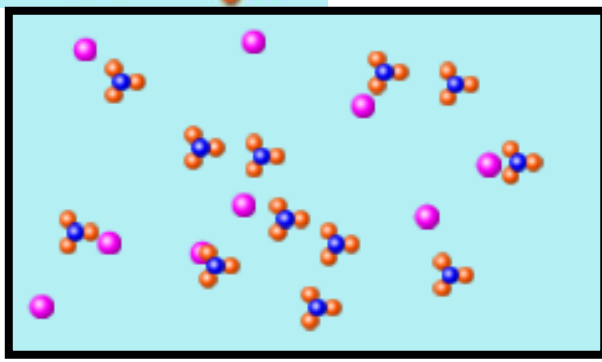


A. Ionic **B. Covalent**

7b How are the particl  **bonded?**

9. If Sodium Chloride is added to this solution, how will the concentrations change?





A. Only the Na^+ will increase

B. Na^+ and Cl^- will increase

C. NO_3^- will decrease

D. More than one of these

Molecule Shapes

Learning Goals: Students will be able to:

- Identify substances to which “Molecular geometry” applies.
- Name molecule and electron geometries for basic molecules.
- Explain the model being used to predict molecule geometry.
- Predict common molecular geometry from the number of electron pairs and bonded atoms around a central atom of basic compounds.

by Trish Loeblein updated October 2011

phet.colorado.edu

1. **Which is a molecule?**

A. CO_2

B. $CaCl_2$

C. NH_4Cl

D. Li_2SO_4

2. **Which would have a linear shape?**

A. **HBr**

B. **CO_2**

C. **Both are linear**

3. **Which has only single bonds?**

A. **HBr**

B. **CO_2**

C. **Both have all single bonds**

4. What shape is water?

A. Tetrahedral

B. Bent

C. Trigonal planar

D. Linear

5. **Which is an example of an exception to the octet rule?**

A. O_2

B. N_2

C. BF_3

D. I_2

E. **More than one of these**

5ans. **Which is an example of an exception to the octet rule?**

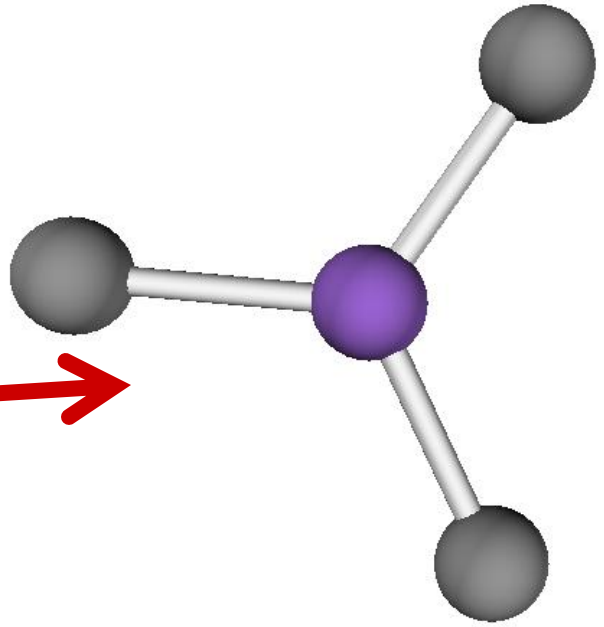
A. O_2

B. N_2

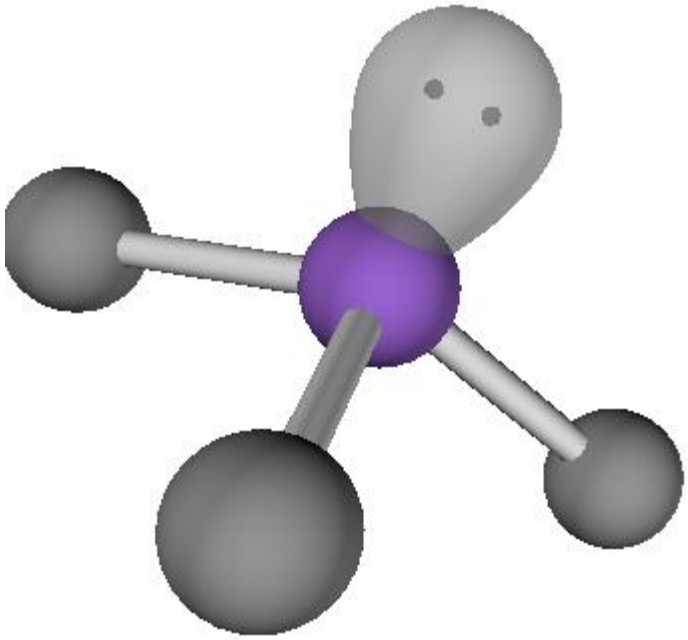
C. BF_3

D. I_2

E. **More than one of these**



6. **Which molecule could be represented with this diagram?**



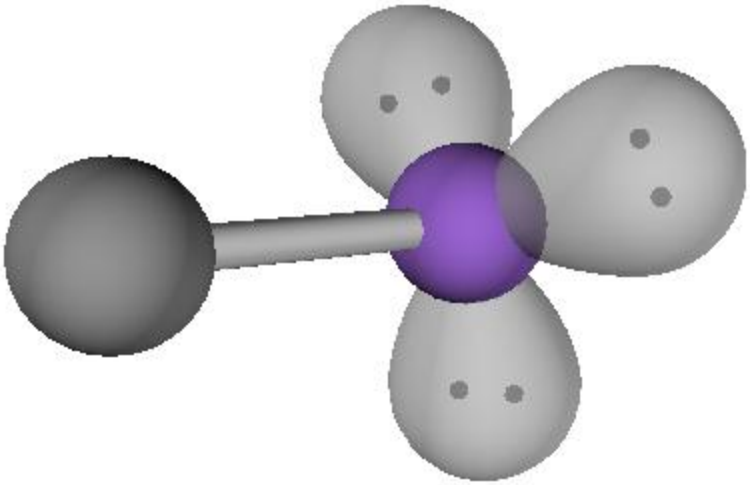
A. BH_3

B. CH_4

C. NH_3

6b. **What would the structural formula look like?**

7. **Which molecule could be represented with this diagram?**



A. HCl

B. CH_4

C. NH_3

D. F_2

7b. **What would the structural formula look like?**

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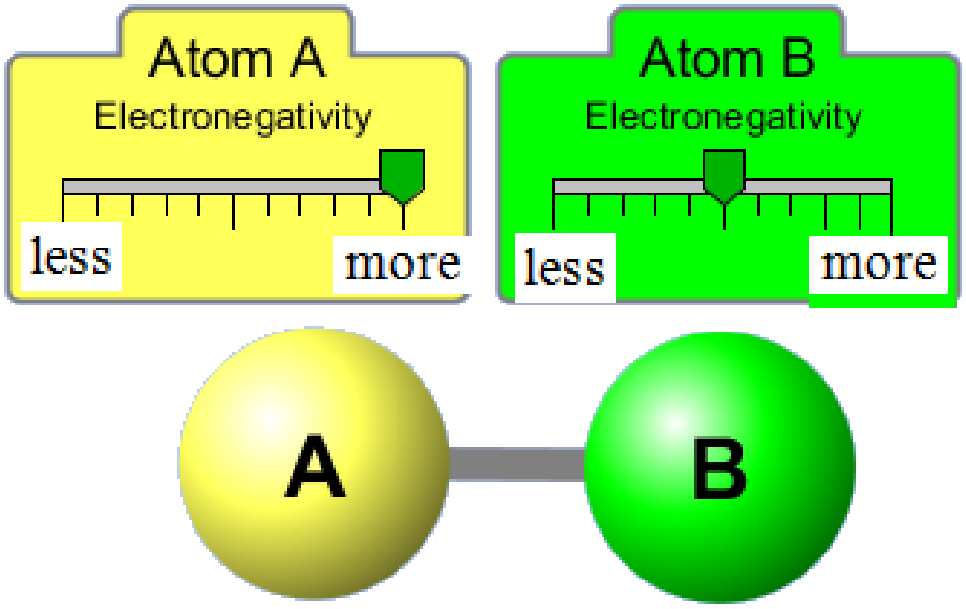
Molecule Polarity

Learning Goals: Students will be able to:

- Define bond polarity and molecular polarity
- Explain the relationships between bond polarity and molecular polarity
- Identify tools/representations to approximate bond and molecular polarity
  - Use these common tools to approximate and compare polarity
- Use standard notation to indicate polarity
- Identify the bonds between atoms as nonpolar covalent, moderately polar covalent, very polar covalent, or ionic.

by Trish Loeblein updated October 2011

1. **Which would represent the correct dipole?**

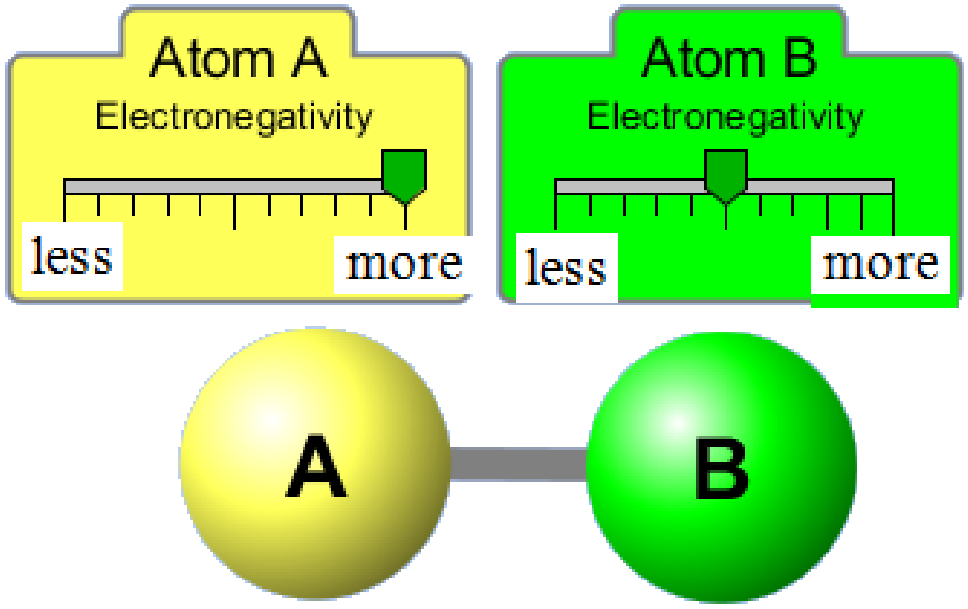


A. ⟶

B. ⟵

C. There is no dipole

2. **Which would be the best description for the bond?**



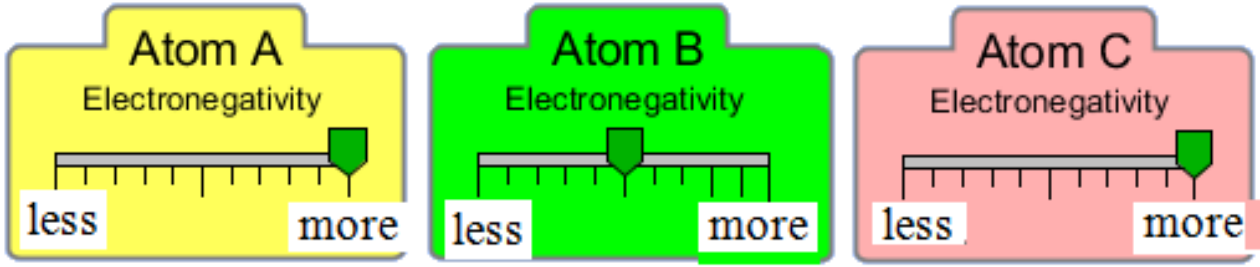
A. nonpolar covalent

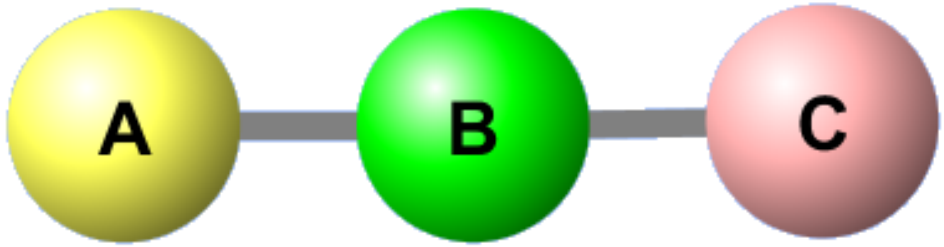
B. moderately polar covalent

C. very polar covalent

D. ionic

3. The molecule shown would be described with





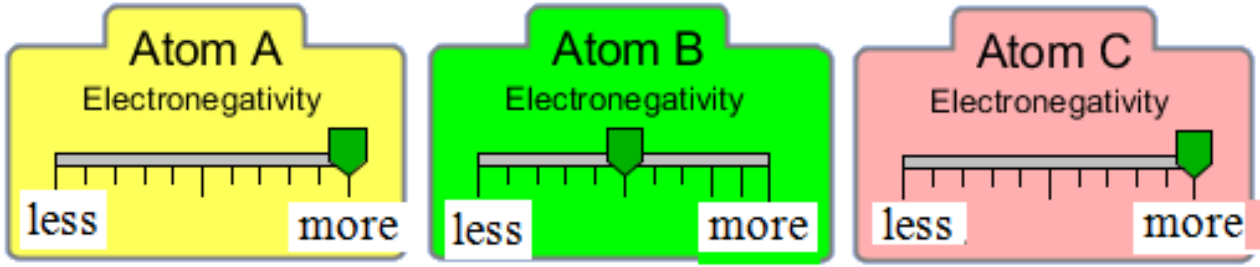
A. polar bonds, nonpolar molecule

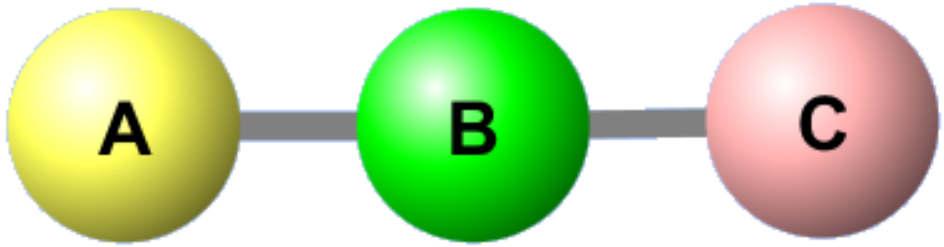
B. nonpolar bonds, nonpolar molecule

C. polar bonds, polar molecule

D. nonpolar bonds, polar molecule

4. The bond dipole and molecular dipole would be





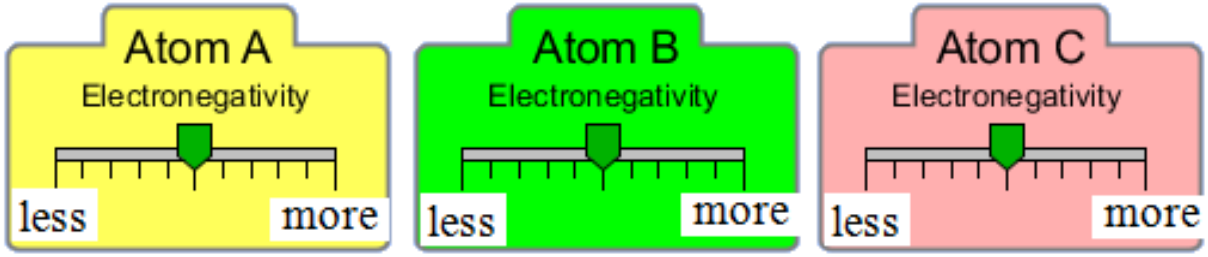
A. ⟵ ⟶ , no molecule dipole

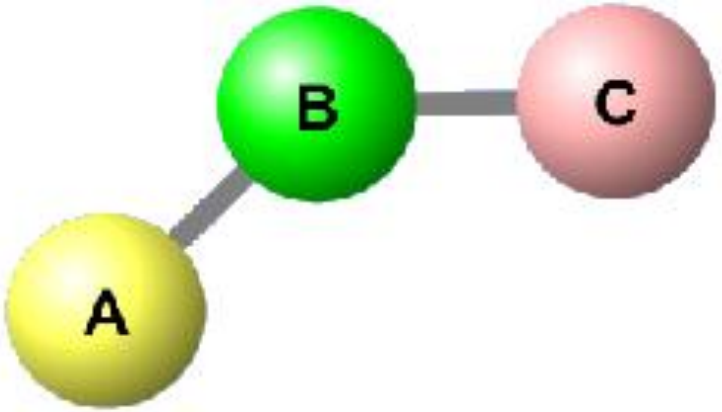
B. ⟵ ⟶ , ⇨

C. ⟶ ⟵ , no molecule dipole

D. ⟶ ⟵ , ⇨

5. **The molecule shown would be described with**





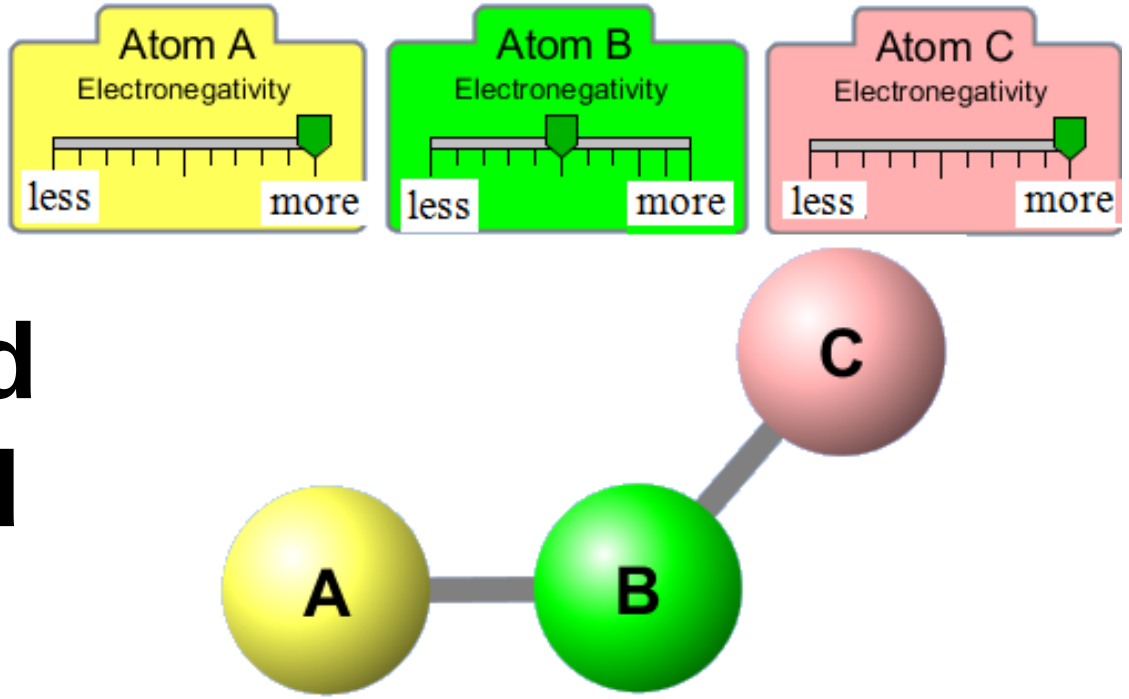
A. polar bonds, nonpolar molecule

B. nonpolar bonds, nonpolar molecule

C. polar bonds, polar molecule

D. nonpolar bonds, polar molecule

6. **The molecule shown would be described with**



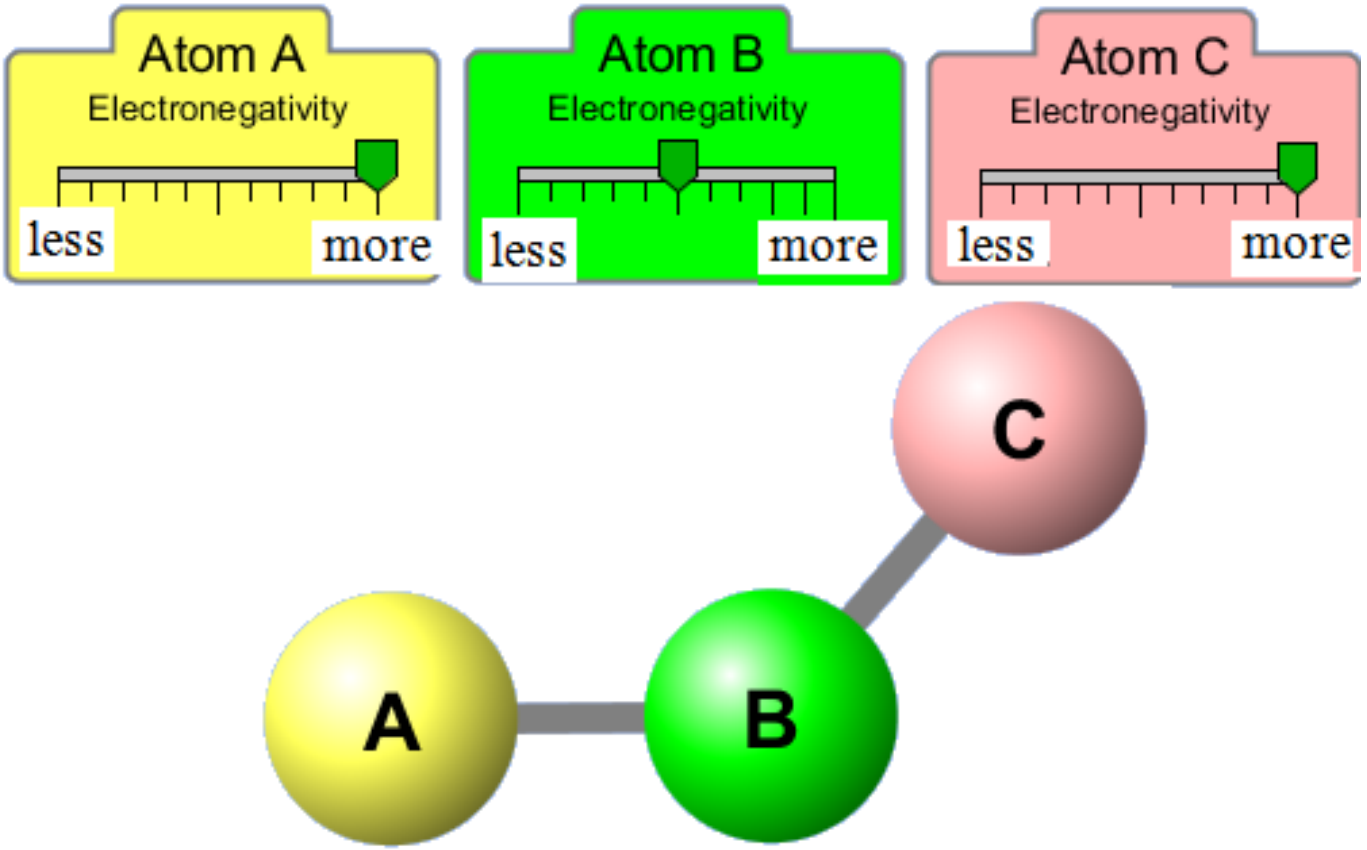
A. polar bonds, nonpolar molecule

B. nonpolar bonds, nonpolar molecule

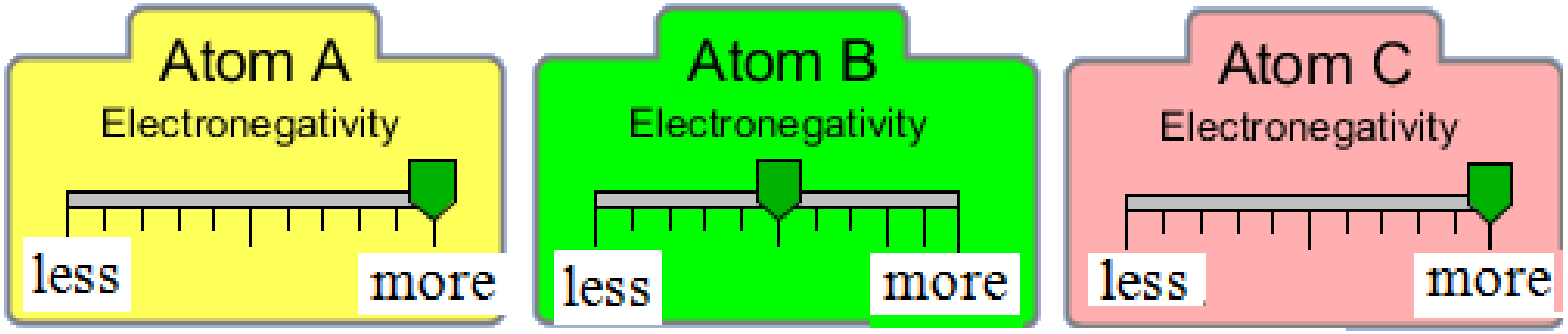
C. polar bonds, polar molecule

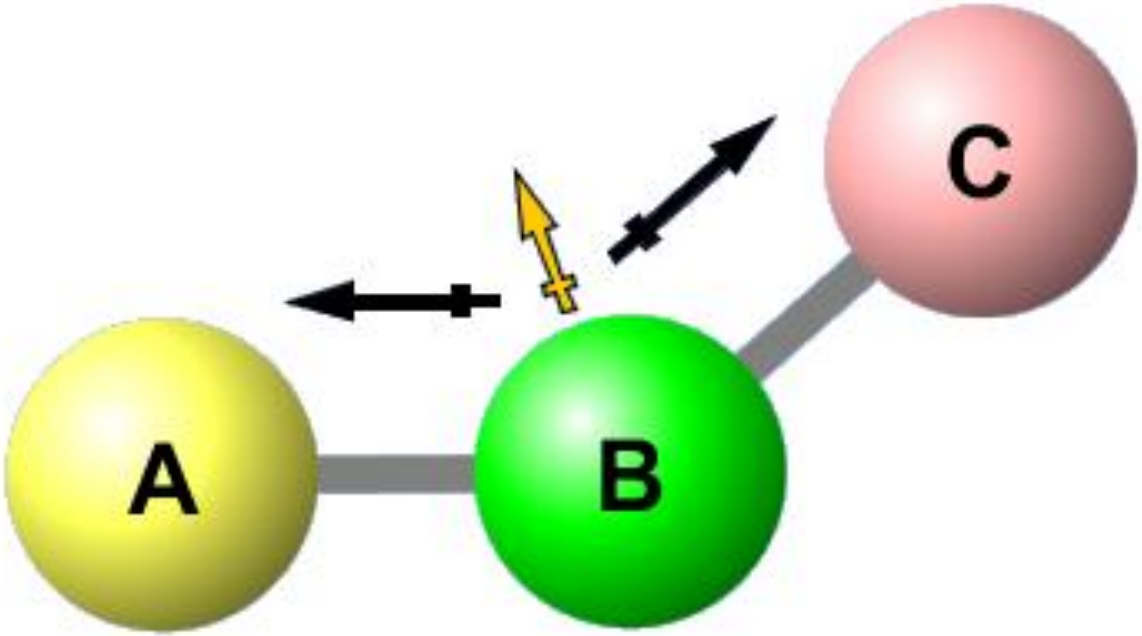
D. nonpolar bonds, polar molecule

7. Draw the dipole representations



7ans. **Draw the dipole representations**





States of Matter Basics

Trish Loeblein

High School Chemistry lesson

January 2012

(this uses the simulation “Basics”, but the full version could be used)

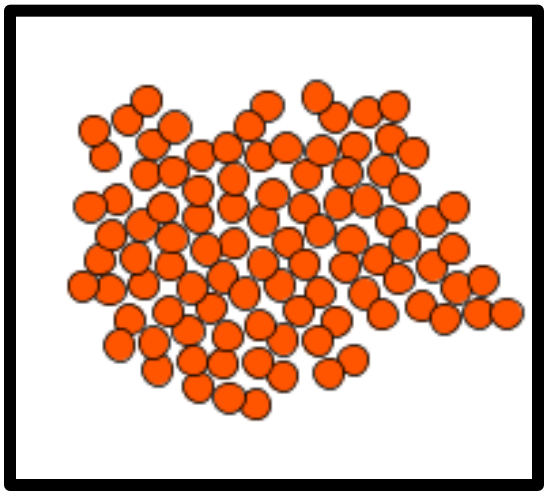
For some questions, I turned on the Teacher menu item “ White background” because it works better with my projector.

Learning Goals:

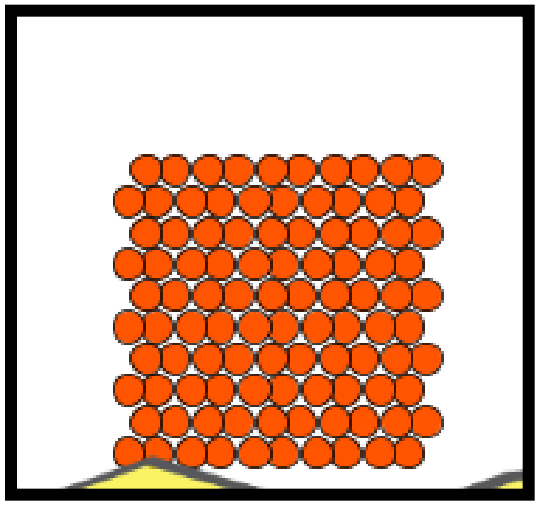
Students will be able to:

- Describe differences and similarities between solids, liquids and gases on a molecular level.
- Explain gas pressure using the Kinetic Theory.
- Determine processes you could use to make solids, liquids and gases change phases.
- Compare and contrast the behavior of the 4 substances in the simulation and use your understanding about molecules to explain your observations.

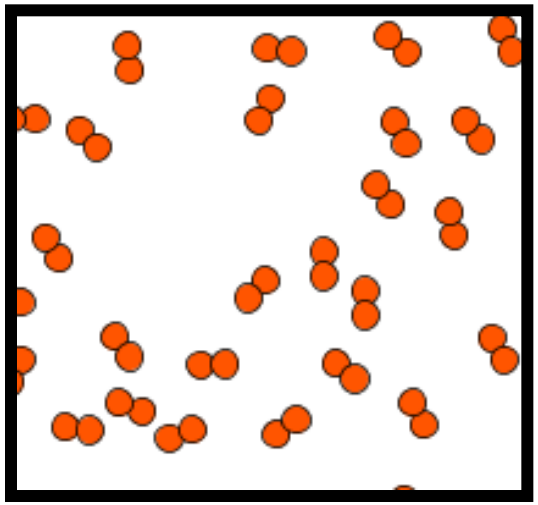
Which is most likely oxygen gas?



A

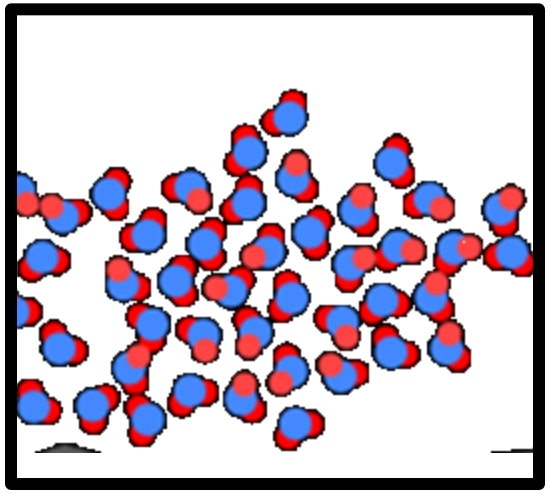


B

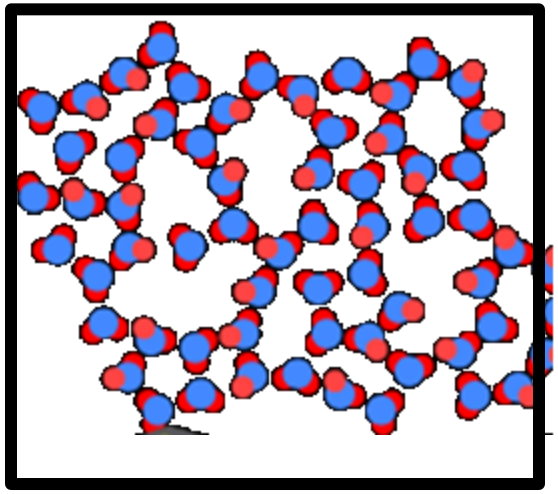


C

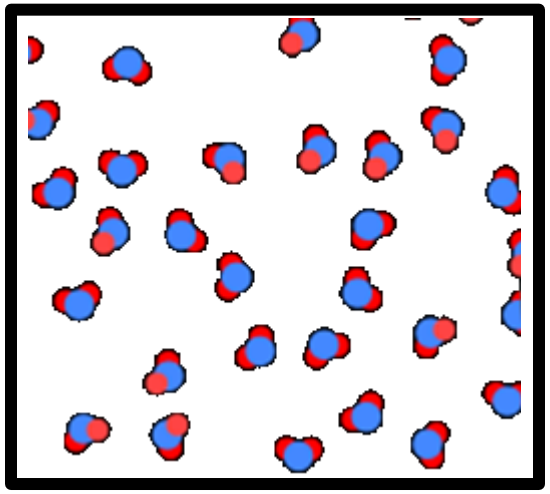
Which is most likely liquid water?



A

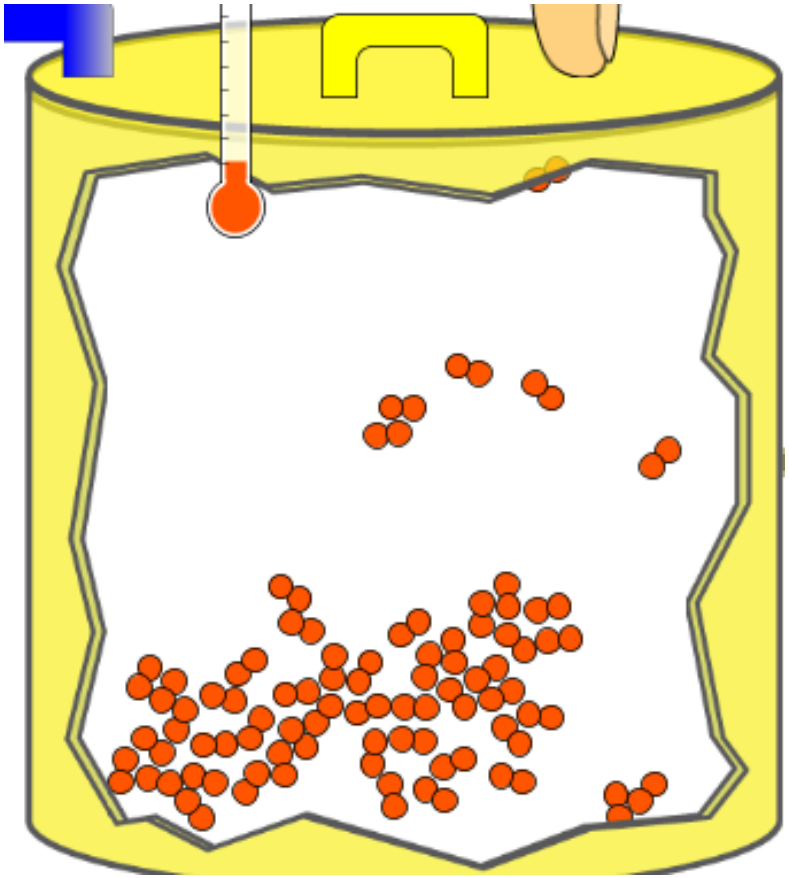


B



C

How could there be 2 phases of oxygen at one temperapture?



Oxygen Liquid-Gas

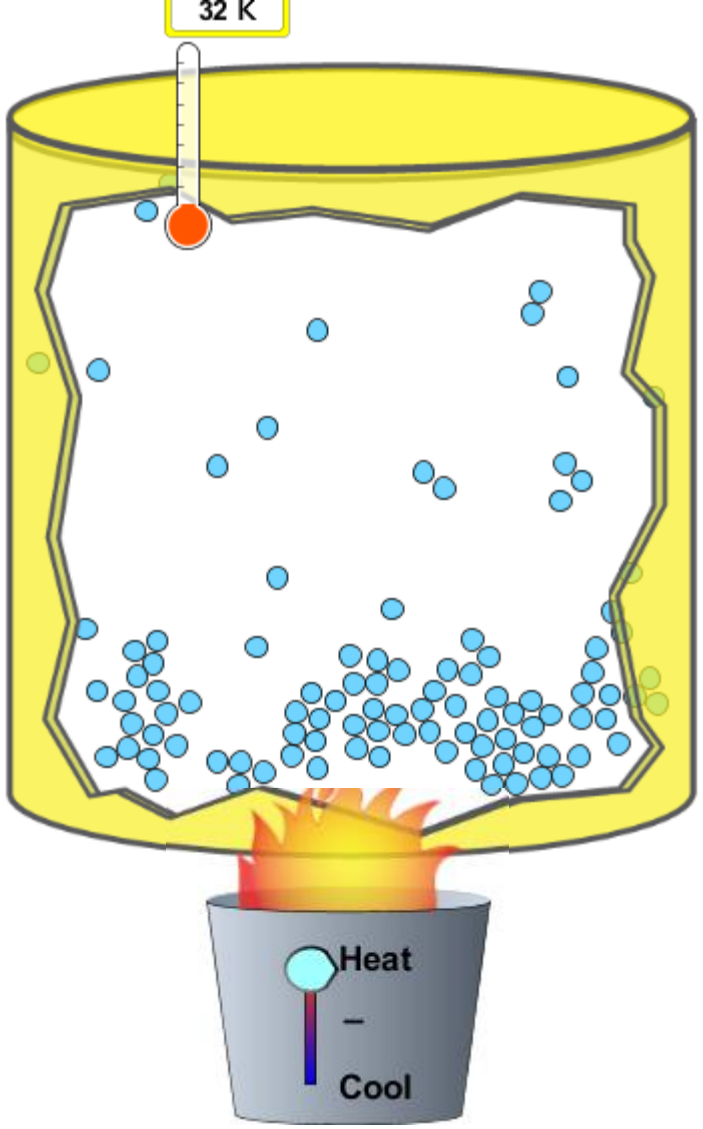
Like water-water vapor in a water bottle

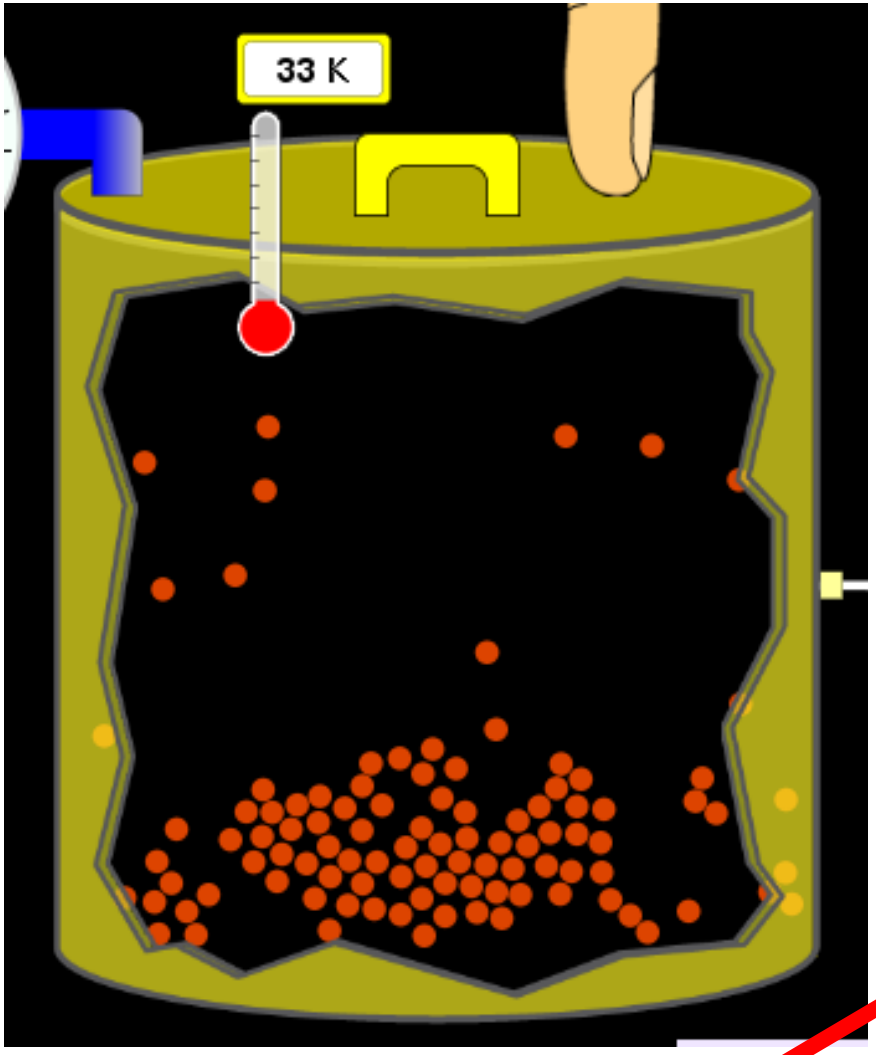
What happens if you add energy using the heater?

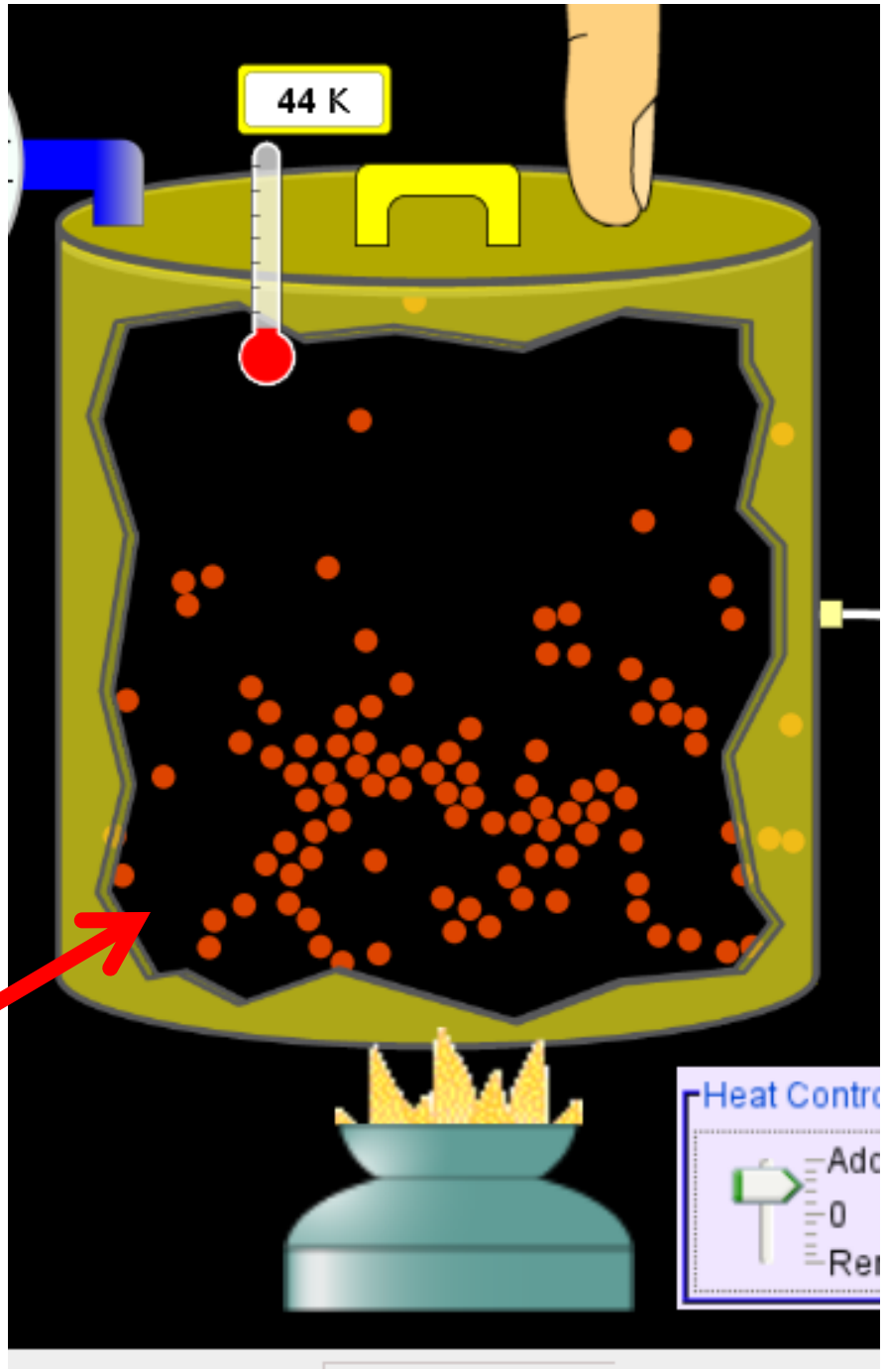
A. No change other than all atoms speed up

B. More atoms would condense

C. More atoms would evaporate

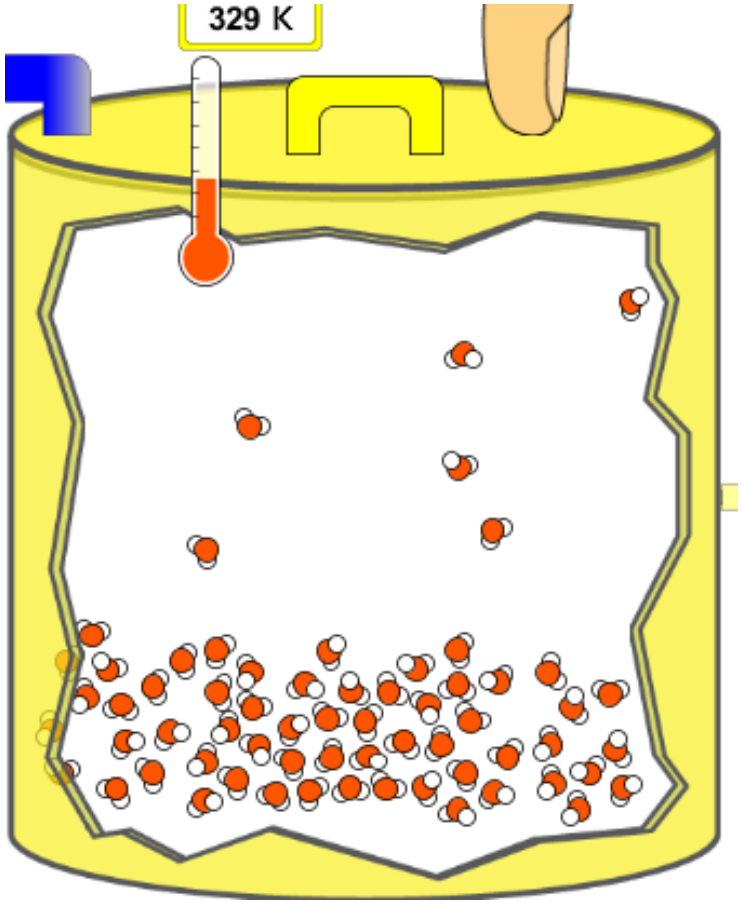






More are gaseous

What happens if you reduce the volume?



A. No change other than the atoms would be closer together.

B. More atoms would condense

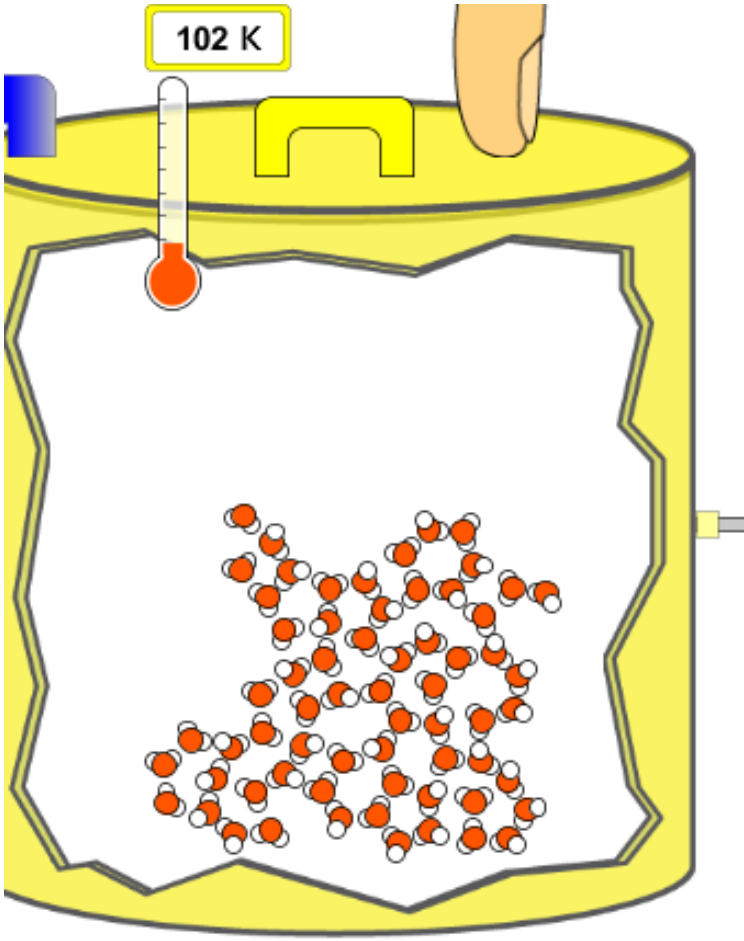
C. More atoms would evaporate

What happens if you reduce the volume a little?

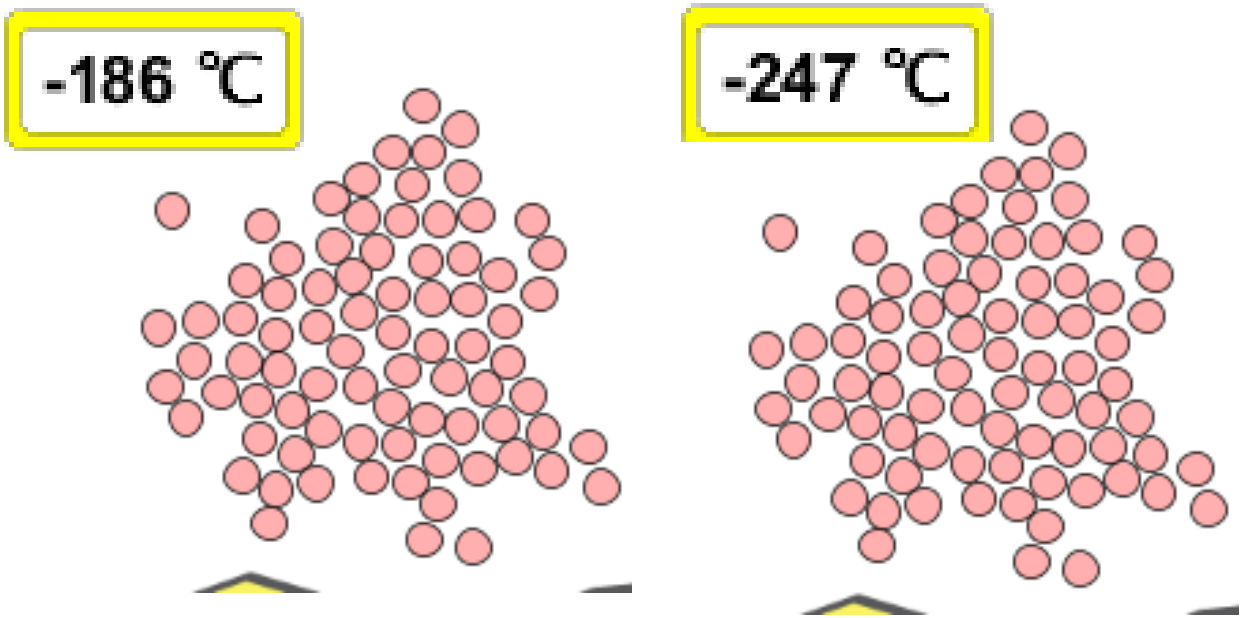
A. No change

B. More atoms would condense

C. More atoms would evaporate



Which liquid material is most likely shown on the left?



A. Argon

B. Neon

C. Water

D. Oxygen

Temperature shown is the melting point.

Density Concept Question

by Trish Loeblein

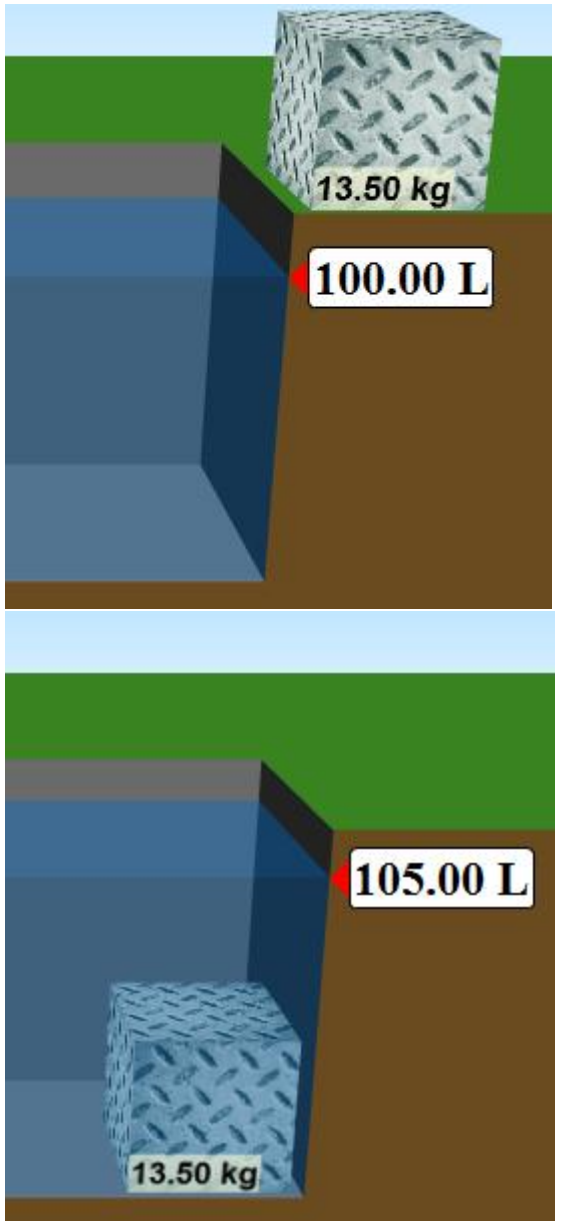
used with Density Activity

Learning Goals:

Students will be able to use macroscopic evidence to:

- Measure the volume of an object by observing the amount of fluid it displaces or can displace.
- Provide evidence and reasoning for how objects of similar:
  - mass can have differing volume
  - volume can have differing mass.
- Identify the unknown materials by calculating density using displacement of fluid techniques and reference tables provided in the simulation.

1. **You put in a pool with 100 L of water. Then you drop an aluminum block in and the volume rises to 105 L. What is the volume of the block?**



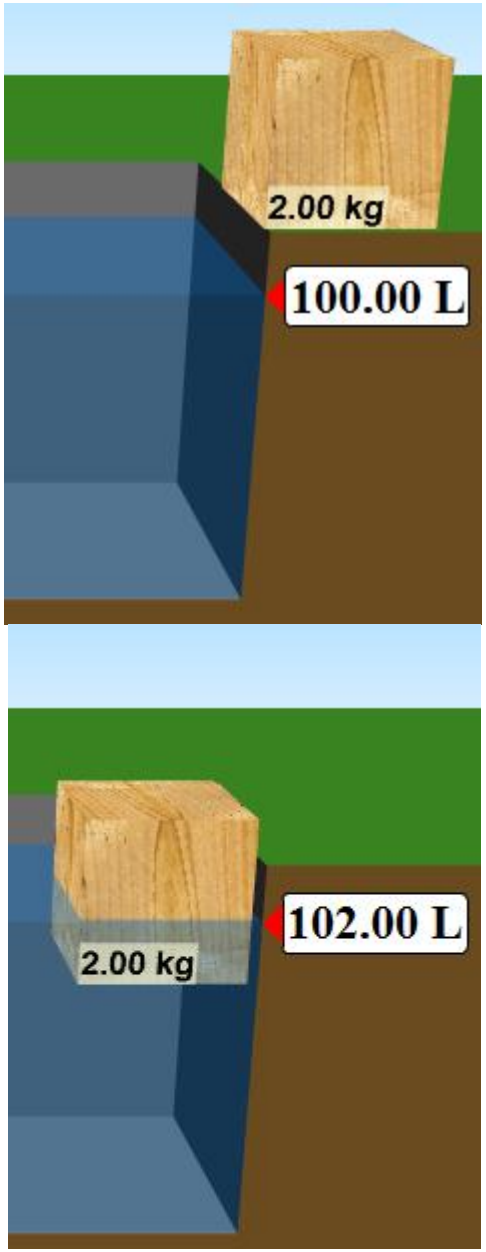
A. 5L

B. 105 L

C. Depends on block shape

D. Not enough

2. **You put in a pool with 100 L of water. Then you drop an wood block in and the volume rises to 102 L. What is the volume of the block?**



A. 5L

B. 105 L

C. Depends on block shape

D. Not enough

3. **Two different blocks, both with a mass of 5 kg have different volumes. How is it possible?**

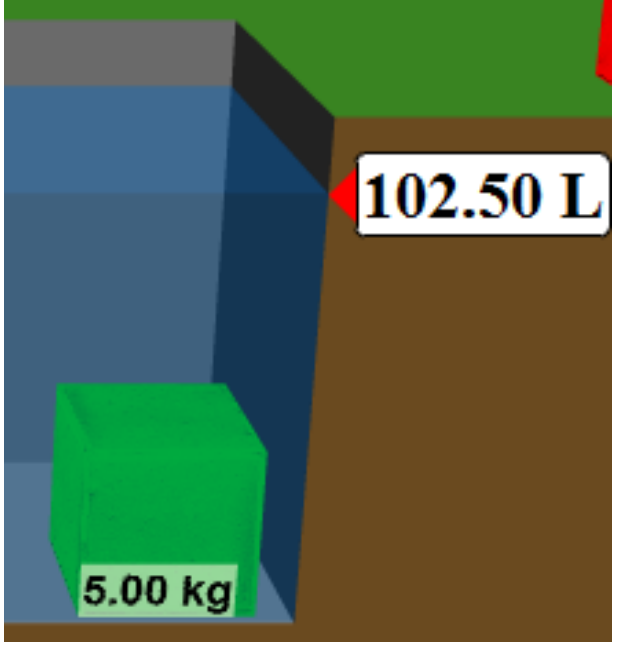
A. One is more dense

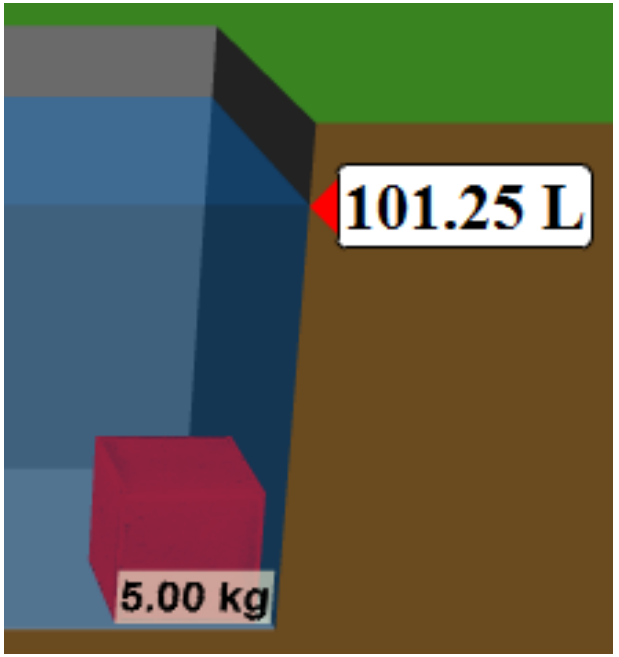
B. They are made of the same material

C. They are made of different material

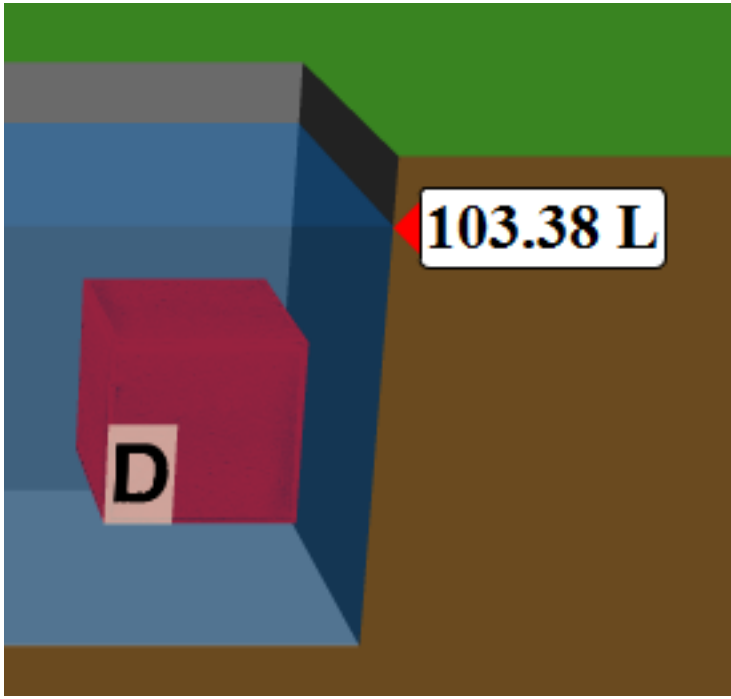
D. More than one of these

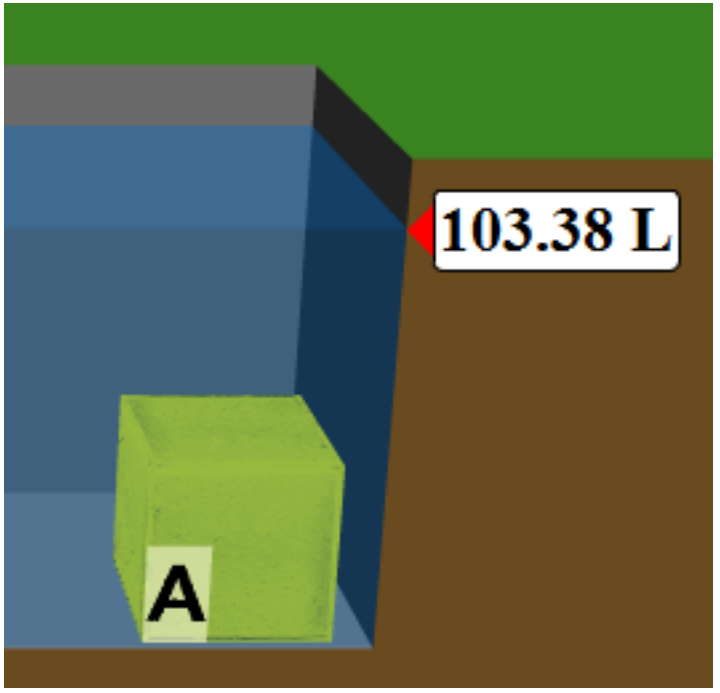
E. None of the above





4. Two different blocks, both with a volume of 3.38L have different mass. What would be a good explanation?





A. A is more dense

B. D is more dense

C. A sinks

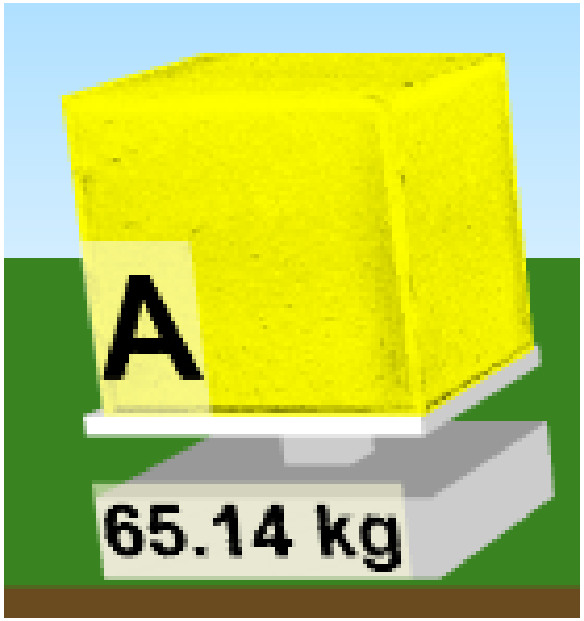
D. D floats

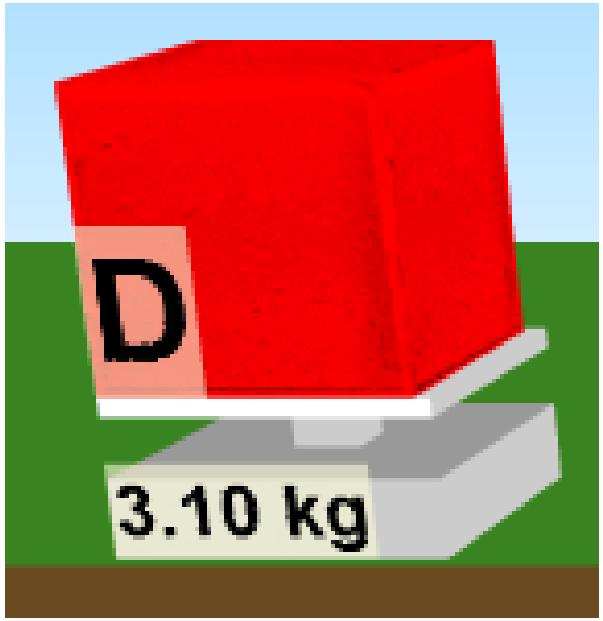
E. More than one of

Some information for 4

Volume changes when

Mass found using scale





It is true that D floats, but it is irrelevant to question. The important thing is that A is more dense – it's mass is greater even though volume is the same.

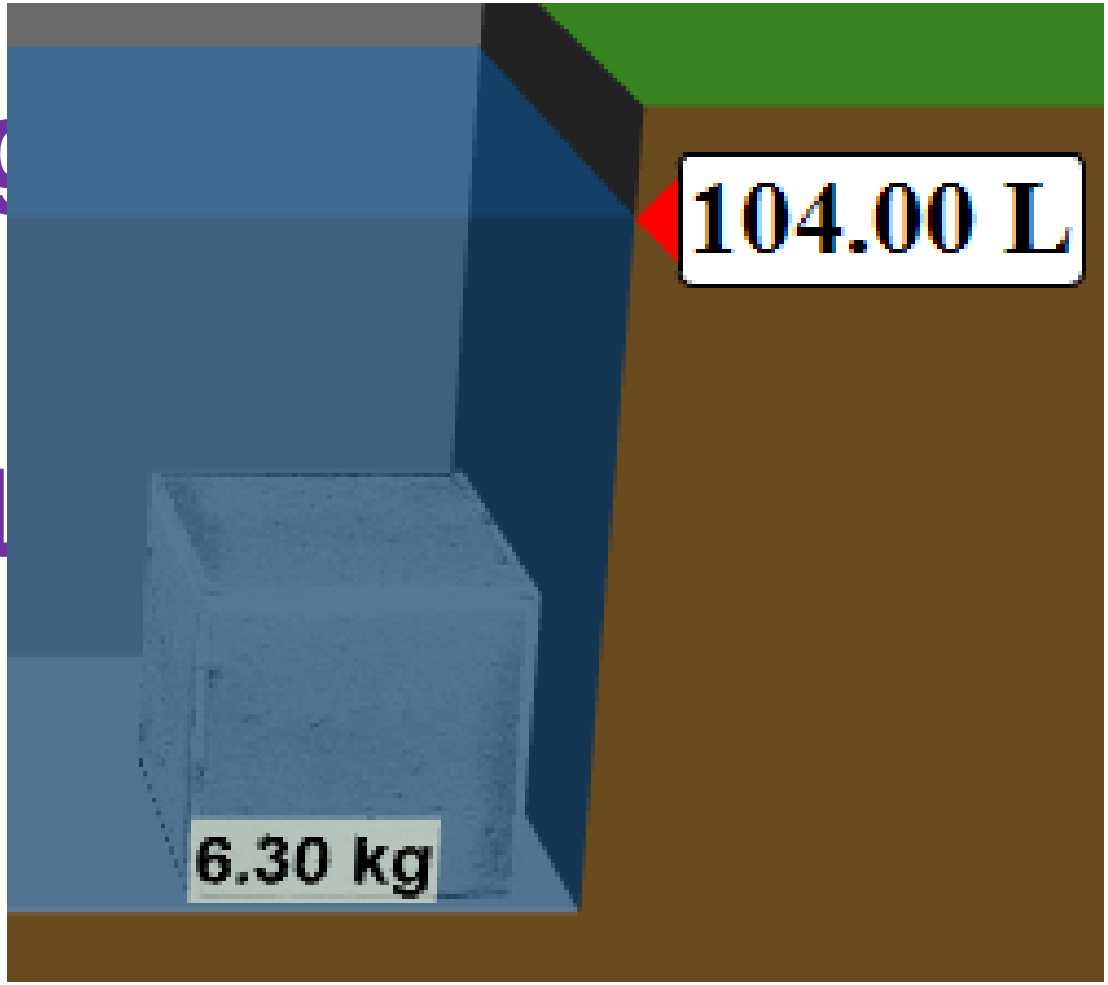
5. What is the density of the block?

A. 0.63 L/kg

B. 1.6 L/kg

C. 0.63 kg/L

D. 1.6 kg/L



6. **Joe was doing a lab. He massed an object and then pushed it into some water. He recorded- 3.5 kg and 5 L. What might the object be?**

	Material	Density (kg/L
A.	Wood	0.40
B.	Apple	0.64
C.	Gasoline	0.70
D.	Diamond	3.53
E.	Lead	11.3

7. What is the mass of the block if it has a density of 0.86?

A. 5.0 kg

B. 91 kg

C. 0.15 kg

D. 6. kg