PhET INTERACTIVE SIMULATIONS

Annotated Lecture Slides for *Concentration*

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COURSE:

Introductory / Preparatory College Chemistry

Learning goals

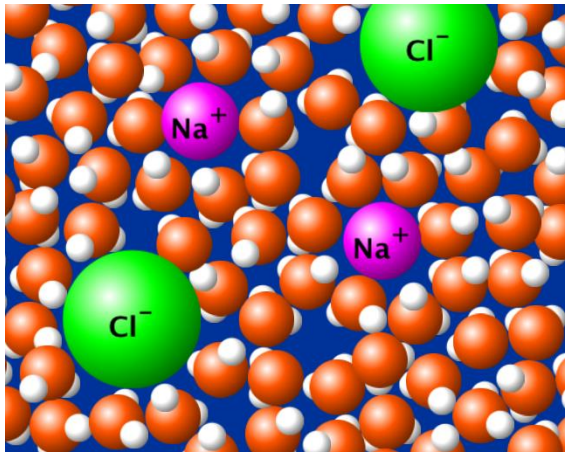
- Distinguish between dilute and concentrated solutions.
- Predict how various actions affect the concentration and number of moles of a solution.
- Use the molarity of a solution to calculate the moles of solute present in a given volume of the solution.
- Use the molarity of a solution to calculate the volume needed to provide a given number of solute moles.
- Calculate final volume or concentration of solutions prepared by dilution

Solutions

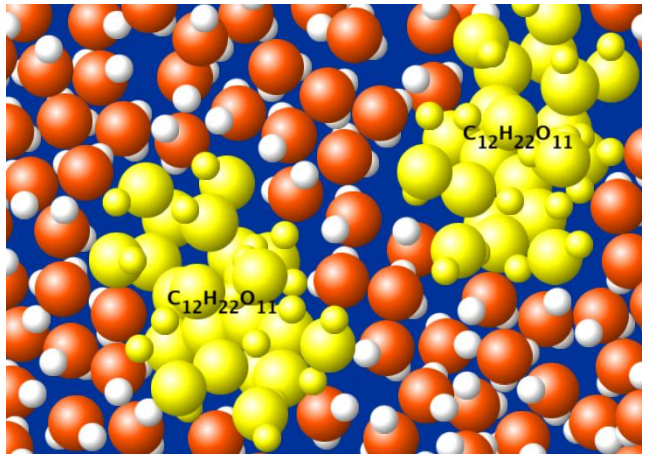
Solute: the substance that is dissolved.

Solvent: the substance that does the dissolving.

– When a solution forms, the solute molecules or ions become evenly dispersed throughout and surrounded by solvent molecules.



Ionic compound



Molecular compound

Glucose highlighted in yellow for visibility

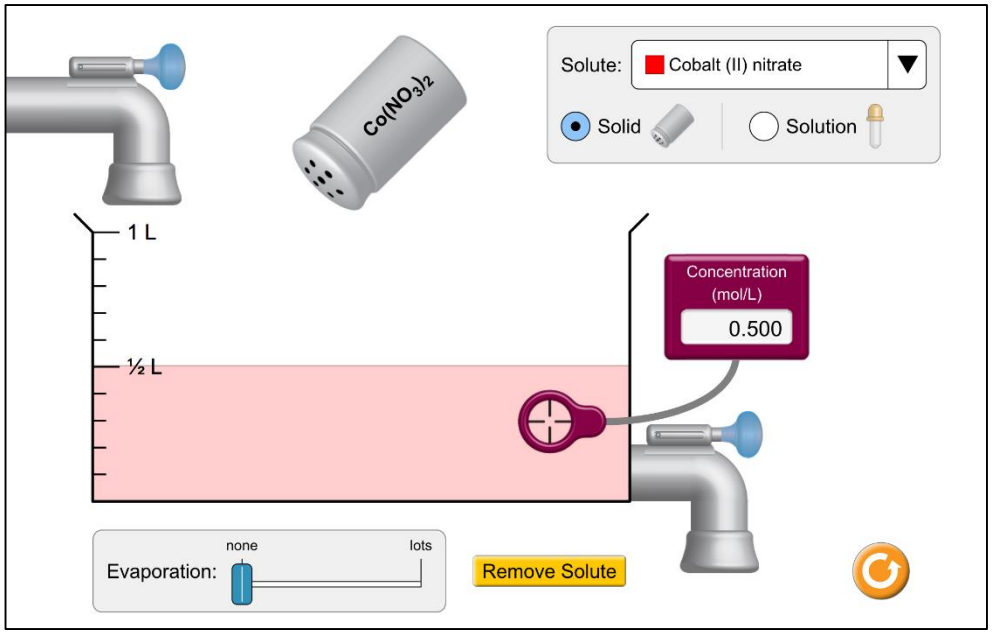
Concentration units: Molarity (M)

$$\text{Molarity (M)} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

- If given mol and L, then can determine M.
- If given mol and M, can determine L.
- If given M and L, can determine mol.

Which action(s) will **increase** the concentration of the solution?

① Add more $Co(NO_3)_2$
② Evaporate water
③ Drain solution

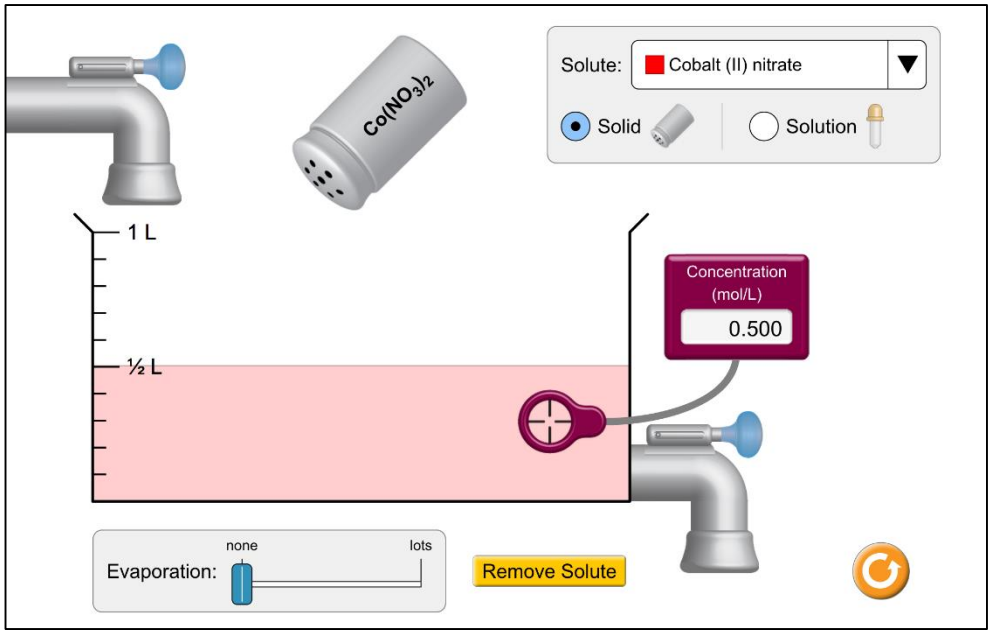


A. (1) only
B. (1) and (2)
C. (2) and (3)
D. (1) and (3)
E. (1), (2), and (3)

Which action(s) will change the <u>number of moles of solute</u> in the container?

① Add water
② Evaporate water
③ Drain solution

A. (1) only
B. (2) only
C. (3) only
D. (1) and (2)
E. (2) and (3)



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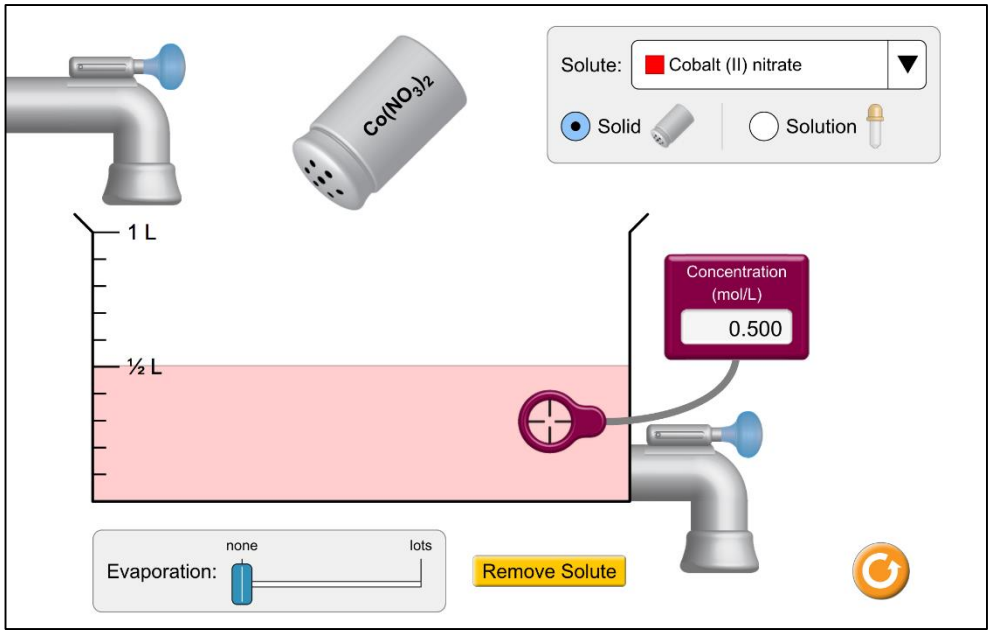

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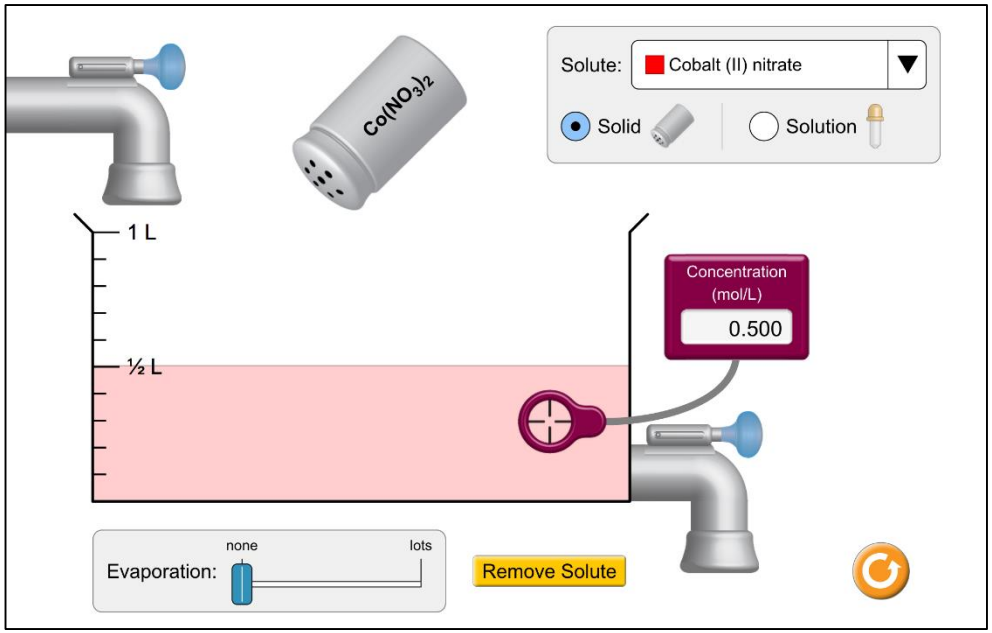
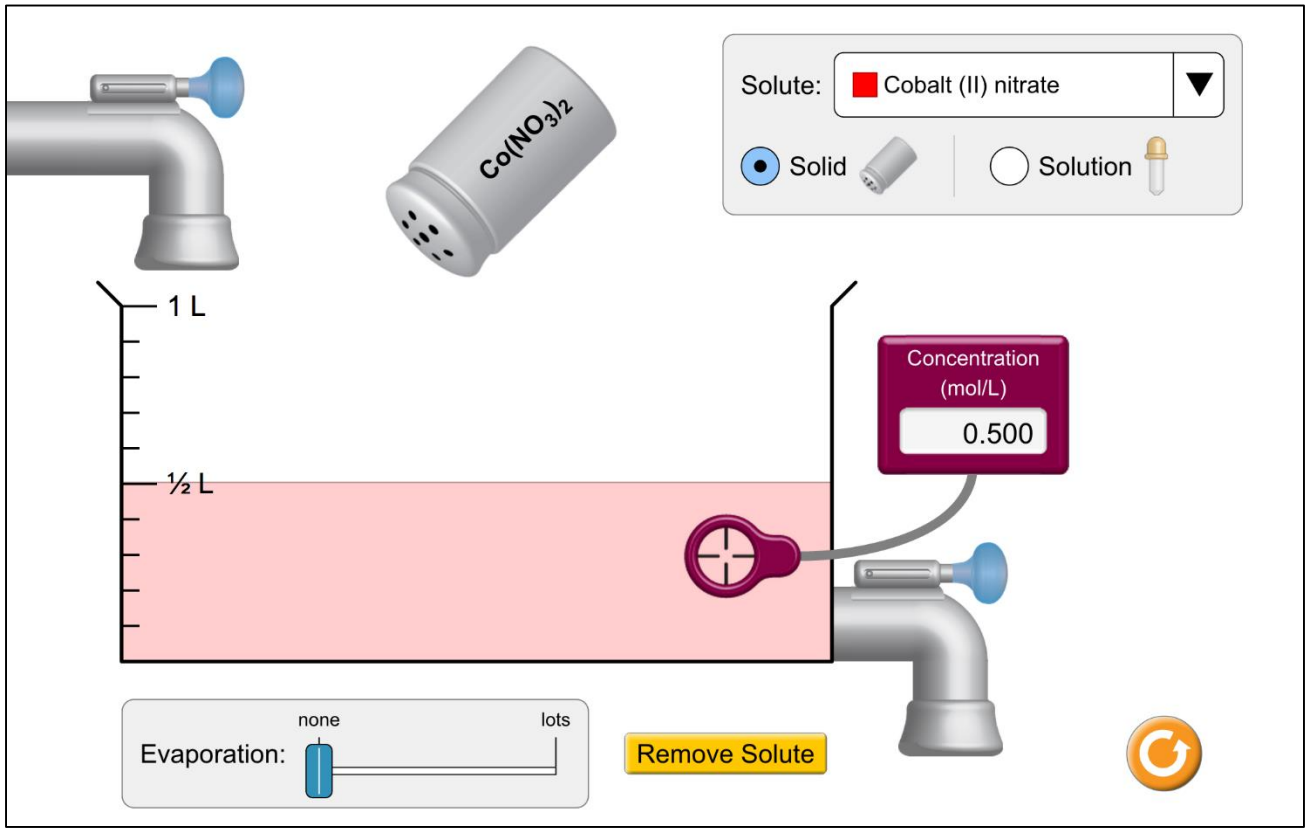


How many moles of solute are in the beaker?



a. 0.05 moles

b. 0.50 moles

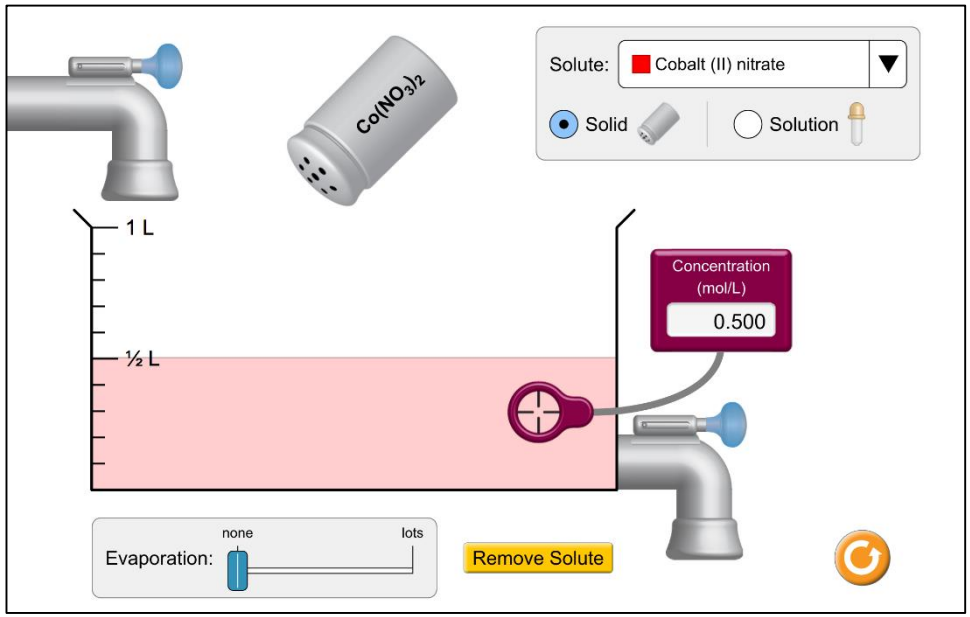
c. 1.00 moles

d. 1.50 moles

e. None of these

What will happen to the concentration and the number of moles when water is added?

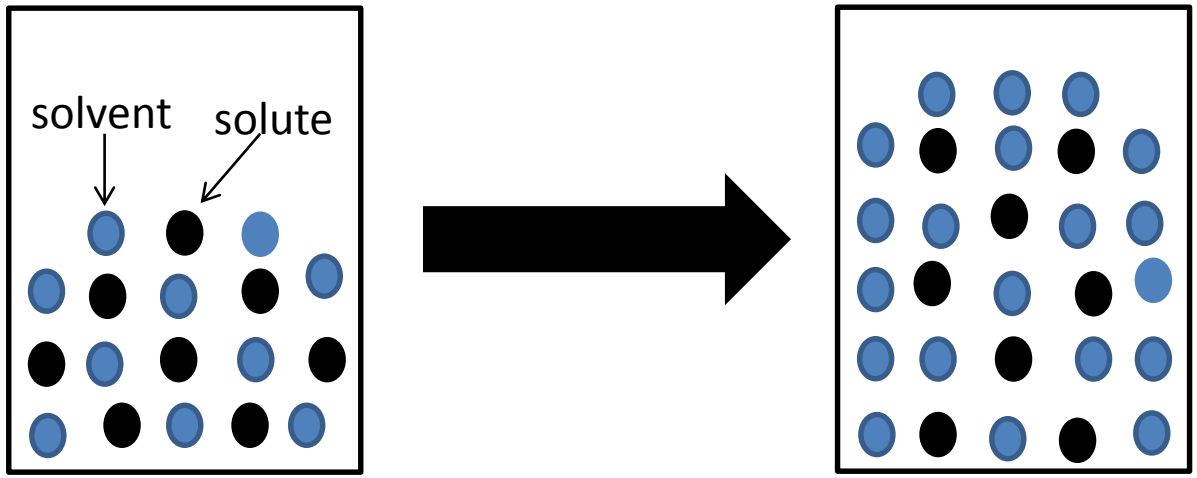
	Concentration	Number of moles
a.	Increase	Decrease
b.	Increase	Increase
c.	No change	No change
d.	Decrease	Decrease
e.	Decrease	No change



Dilutions

- To decrease the concentration of a solution, add more solvent
  - The number of solute particles stay the same, but the number of solvent particles increases and the ratio of solute/solvent particles also changes
  - This means that the total volume also increases

Ratio of solute/solvent: 8/10



Ratio of solute/solvent: 8/20

Dilutions

- Usually, a more concentrated solution is used to make the dilute solutions
- Equation: “moles equals moles”
- $M_{dil}V_{dil}= M_{conc}V_{conc}$

- M_{dil} = Desired dilute molarity
- V_{dil} = desired total volume
- M_{conc} = Concentrated molarity (stock solution)
- V_{conc} = Volume of concentrated solution

You start with 0.1 L of a 5.00 M solution of $NiCl_2$, and you plan to dilute it (by adding water) to make a solution with a concentration of 0.625 M. How far should you fill the beaker?

a. 200 mL

b. 400 mL

c. 600 mL

d. 800 mL

e. 1 L