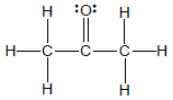
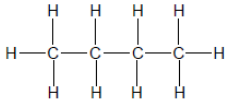
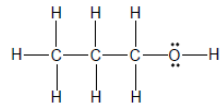
Unit 9: IMFs, Solid Bonding

Name: _____ Pd____

CHAPTER 11 – 12 PRACTICE QUIZ

←Linked at 0:00

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

Name	Structural Formula	Molar Mass (g/mol)
acetone		58.1
butane		58.1
1-propanol		60.1

1. The table above shows the structural formulas and molar masses for three different compounds. Which of the following is a list of the compounds in order of increasing boiling points?

   (A) butane < 1-propanol < acetone

   (B) butane < acetone < 1-propanol

   (C) 1-propanol < acetone < butane

   (D) acetone < butane < 1-propanol

2. Which of the following statements is the most appropriate based on the physical properties of solids?

   (A) Ionic solids tend to have higher melting points than molecular solids.

   (B) Metallic solids tend to have higher melting points than covalent-network solids.

   (C) Ionic compounds are excellent conductors of electricity in the solid phase.

   (D) Molecular solids are excellent conductors of electricity when dissolved into water.

	NaF	MgO
Boiling Point (°C)	1695	3600

	Na^+	Mg^{2+}	F^-	Cl^-	O^{2-}
Ionic Radius (pm)	76	72	133	181	140

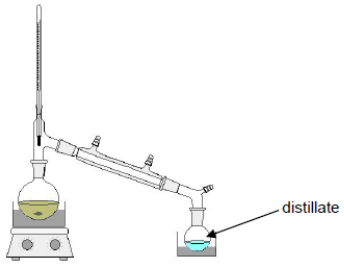
3. Based on the data in the tables above, which of the following statements provides the best prediction for the boiling point of NaCl?

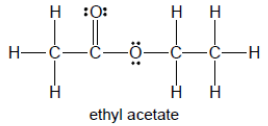
   (A) NaCl will have a lower boiling point than NaF because the coulombic attractions are weaker in NaCl than in NaF.

   (B) NaCl will have a boiling point between that of NaF and MgO because the covalent character of the bonds in NaCl is intermediate between that of NaF and MgO.

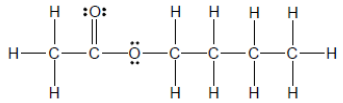
   (C) NaCl will have a higher boiling point than MgO because the ions are spaced farther apart in NaCl than in MgO.

   (D) NaCl will have a higher boiling point than MgO because the electron cloud in NaCl is larger and more polarizable than it is in MgO.





ethyl acetate



butyl acetate

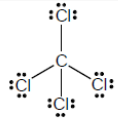
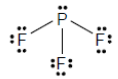
4. A mixture containing equal numbers of moles of ethyl acetate and butyl acetate was separated using distillation. Based on the diagrams shown above, which of the following identifies the substance that would be initially present in higher concentration in the distillate and correctly explains why that occurs?

   (A) Ethyl acetate, because it has fewer C–C bonds to break

   (B) Ethyl acetate, because it has a shorter carbon chain and weaker London dispersion forces

   (C) Butyl acetate, because it has more C–C bonds to break

   (D) Butyl acetate, because it has a longer carbon chain and stronger London dispersion forces

Substance	Boiling Point (K)
	350
	171

5. Which of the following statements provides the best explanation for the different boiling points shown in the table above?

   (A) The London dispersion forces between CCl_4 molecules are stronger than the London forces between PF_3 molecules.

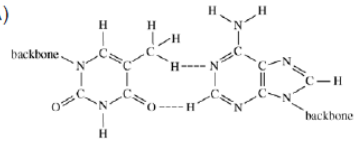
   (B) The dipole-dipole forces between CCl_4 molecules are stronger than the dipole-dipole forces between PF_3 molecules.

   (C) The London dispersion forces between PF_3 molecules are stronger than the London forces between CCl_4 molecules.

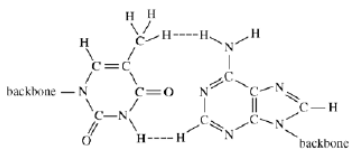
   (D) The dipole-dipole forces between PF_3 molecules are stronger than the dipole-dipole forces between CCl_4 molecules.

6. Thymine and adenine form a base pair in the DNA molecule. These two bases can form a connection between two strands of DNA via two hydrogen bonds. Which of the following diagrams shows the correct representation of the hydrogen bonding (denoted by dashed lines) between thymine and adenine base pairs? (In each diagram, thymine is shown at the left and adenine is shown at the right. The bases are attached to the backbone portion of the DNA strands.)

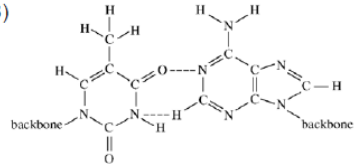
(A)



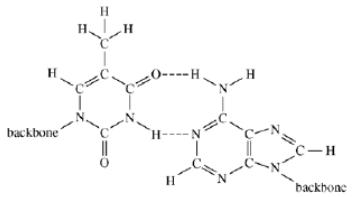
(C)



(B)



(D)



Substance	Equilibrium Vapor Pressure at 20°C (torr)
$C_6H_6(l)$	75
$C_2H_5OH(l)$	44
$CH_3OH(l)$	92
$C_2H_6O_2(l)$	0.06

7. Based on the data in the table above, which of the following liquid substances has the weakest intermolecular forces?

(A) $C_6H_6(l)$ (B) $C_2H_5OH(l)$ (C) $CH_3OH(l)$ (D) $C_2H_6O_2(l)$

Ion	Ionic Radius (pm)
Zn^{2+}	74
Ca^{2+}	100
Ba^{2+}	135

8. Based on the data in the table above, which of the following correctly predicts the relative strength of the attraction of Zn^{2+}, Ca^{2+}, and Ba^{2+} ions to water molecules in a solution, from strongest to weakest, and provides the correct reason?

(A) $Zn^{2+} > Ca^{2+} > Ba^{2+}$ because the smaller ions have a stronger coulombic attraction to water

(B) $Zn^{2+} > Ca^{2+} > Ba^{2+}$ because the smaller ions are more electronegative

(C) $Ba^{2+} > Ca^{2+} > Zn^{2+}$ because the larger ions are more polarizable

(D) $Ba^{2+} > Ca^{2+} > Zn^{2+}$ because the larger ions are less electronegative

9. A sample of a hard, solid binary compound at room temperature did not conduct electricity as a pure solid but became highly conductive when dissolved in water. Which of the following types of interactions is most likely found between the particles in the substance?

(A) Ionic bonds

(B) Metallic bonds

(C) Covalent bonds

(D) Hydrogen bonds

Element	Metallic Radius (pm)	Melting Point (°C)	Common Oxidation State
Au	144	1064	1+, 3+
Cu	128	1085	1+, 2+
Ag	144	961	1+

10. To make Au stronger and harder, it is often alloyed with other metals, such as Cu and Ag. Consider two alloys, one of Au and Cu and one of Au and Ag, each with the same mole fraction of Au. If the Au/Cu alloy is harder than the Au/Ag alloy, then which of the following is the best explanation based on the information in the table above?

(A) Cu has two common oxidation states, but Ag has only one.

(B) Cu has a higher melting point than Au has, but Ag has a lower melting point than Au has.

(C) Cu atoms are less polarizable than Ag atoms are; thus Cu has weaker interparticle forces.

(D) Cu atoms are smaller than Ag atoms; thus they interfere more with the displacement of atoms in the alloy.

11. At room temperature $I_2(s)$ is a molecular solid. Which of the following provides a characteristic of $I_2(s)$ with a correct explanation?

(A) It has a high melting point because it has weak intermolecular forces.

(B) It is hard because it forms a three-dimensional covalent network.

(C) It is very soluble in water because its molecules are polar.

(D) It is not a good conductor of electricity because its valence electrons are localized in bonding and nonbonding pairs.

12. Which of the following processes involves breaking covalent bonds?

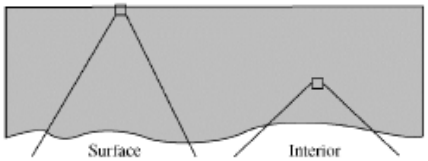
(A) $C_{10}H_8(s) \rightarrow C_{10}H_8(g)$

(B) $HF(l) \rightarrow HF(g)$

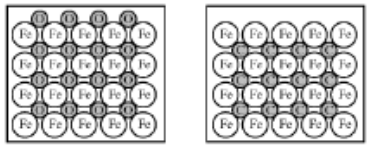
(C) $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$

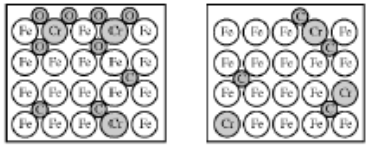
(D) $Cl_2(g) \rightarrow 2\,Cl(g)$

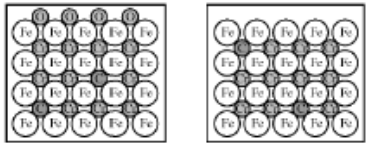
13. Steel is an alloy consisting of Fe with a small amount of C. Elemental Cr can be added to steel to make the steel less likely to rust; Cr atoms react with oxygen in the air to form a nonreactive layer of chromium oxide on the surface of the steel, preventing the oxidation of underlying Fe atoms. A sample of steel-chromium alloy contains 15 percent Cr by mass. Which of the following diagrams best shows a particle-level view of a surface section and an interior section of the alloy represented below at the left? (The atomic radii of the atoms involved are given in the table below at the right.)

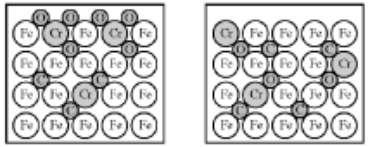


Element	Molar Mass (g/mol)	Atomic Radius (pm)
Fe	55.85	125
Cr	52.00	127
C	12.01	77
O	16.00	73

(A)


(B)


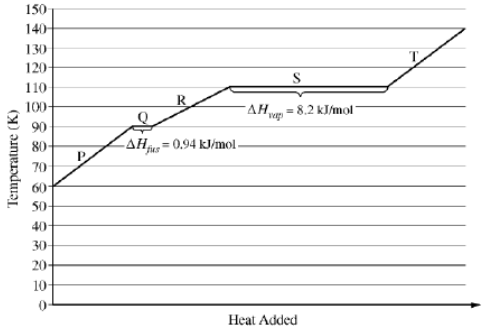
(C)


(D)


Substance	Formula
Hexane	$CH_3CH_2CH_2CH_2CH_2CH_3$
Octane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

14. The formulas of hexane and octane are shown in the table above. Which of the following lists is arranged in order of increasing viscosity?

	Lowest viscosity	- - - - >	Highest viscosity
(A)	hexane @ 25°C	octane @ 25°C	octane @ 45°C
(B)	octane @ 25°C	hexane @ 25°C	hexane @ 45°C
(C)	hexane @ 25°C	hexane @ 45°C	octane @ 45°C
(D)	hexane @ 45°C	hexane @ 25°C	octane @ 25°C



15. The graph above represents the heating curve for methane (CH_4). Which of the following best explains why more energy is required for the process occurring at 110 K than for the process occurring at 90 K?

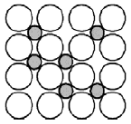
(A) Intermolecular attractions are completely overcome during vaporization.

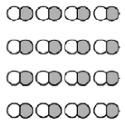
(B) Intermolecular attractions in the solid phase are weaker than in the liquid phase.

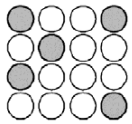
(C) The electron cloud of CH_4 becomes more polarizable at higher temperatures.

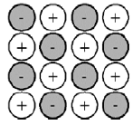
(D) The vaporization process involves a larger increase in temperature than the fusion process.

16. Which of the following diagrams best depicts an alloy of Ni and B?

(A)


(B)


(C)


(D)


17. Silicon crystals are semiconductors. Which of the following is a correct reason for the increase in the conductivity of Si crystals when a small fraction of Si atoms are replaced with those of a different element?

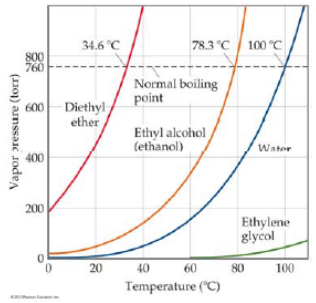
(A) P atoms introduce additional mobile negative charges.

(B) P atoms introduce additional mobile positive charges.

(C) Ge atoms have more electrons than Si atoms have.

(D) Ge atoms are much smaller than Si atoms.

Temperature (°C)	Vapor Pressure of Compound X (torr)
60	175
65	220
70	275
75	345
80	425
85	520
90	640
95	780



18. The table above lists the vapor pressure of Compound X at various temperatures. Based on this information as well as the information in the graph shown above, which of the following statements is most likely to be true concerning Compound X?

(A) It experiences stronger intermolecular attractive forces than ethyl alcohol does.

(B) It experiences stronger intermolecular attractive forces than ethylene glycol does.

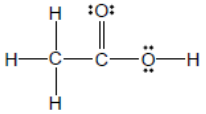
(C) Its boiling point is lower than the boiling point of ethyl alcohol.

(D) Its boiling point is higher than the boiling point of water.

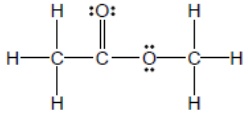
CHAPTER 11 – 12 PRACTICE QUIZ

FREE RESPONSE – CALCULATOR IS ALLOWED

←Linked at 20:19



acetic acid



methyl acetate

1. (a) Place a check (✓) in each of the appropriate boxes in the table below to indicate the type of intermolecular attractive forces experienced by each substance. It is possible for a substance to experience more than one type of attractive force.

Substance	London dispersion forces	Dipole-dipole forces	Hydrogen bonding
acetic acid			
methyl acetate			

BP of acetic acid = 118°C BP of methyl acetate = 57°C

(b) Select one of the following statements that provides the best justification for the boiling point data shown above.

_____ Methyl acetate has a larger electron cloud and is more polarizable than acetic acid is.

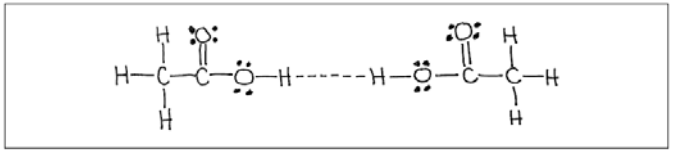
_____ Methyl acetate contains more hydrogen atoms than acetic acid, so it has more opportunities to form hydrogen bonds than acetic acid does.

_____ The London dispersion forces in acetic acid are stronger than the London dispersion forces in methyl acetate.

_____ Acetic acid experiences hydrogen bonding attractions; however, methyl acetate does not experience hydrogen bonding attractions.

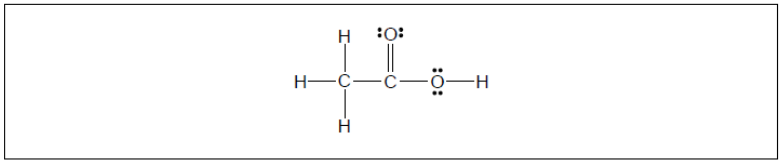
1. continued

A student drew the following diagram to indicate the strongest type of intermolecular attractive force between two acetic acid molecules.

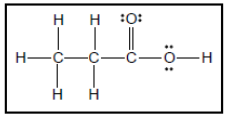


(c) The student's drawing is incorrect. Your job is to draw the diagram correctly. The box below shows one molecule of acetic acid. Your instructions are the following.

- Draw a second molecule of acetic acid in the box below.
- Draw a dashed line (----------) to indicate the strongest type of intermolecular attractive force that exists between the two acetic acid molecules.
- Each end of the dashed line should be connected to a specific atom on each acetic acid molecule so that the attractive force between the molecules is indicated correctly.

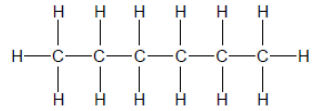
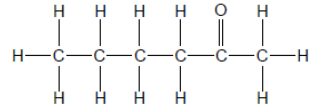


(d) Propanoic acid, shown at right, has a boiling point of 141°C.



(i) Identify <u>all</u> the types of intermolecular forces present among the molecules in propanoic acid.

(ii) Which of the types of intermolecular forces that you identified in part (d)(i) is <u>most</u> responsible for the difference in boiling points of acetic acid and propanoic acid?

Substance	Structural Formula	Vapor Pressure at 20°C (torr)
hexane		132
2-hexanone		10

2. (a) Place a check (✓) in each of the appropriate boxes in the table below to indicate the type of intermolecular attractive forces experienced by each substance. It is possible for a substance to experience more than one type of attractive force.

Substance	London dispersion forces	Dipole-dipole forces	Hydrogen bonding
hexane			
2-hexanone			

(b) In terms of the relative strength of the intermolecular forces, explain why hexane has a higher vapor pressure than 2-hexanone at 20°C.

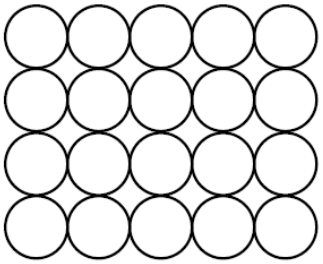
(c) Which liquid, hexane or 2-hexanone, should have a higher boiling point?

Element	Atomic Radius (pm)
Cu	135
Zn	135

3. Brass is an alloy of copper and zinc. The atomic radii of the metals are given in the table above. In the diagram below, use the following symbols for atoms of copper and zinc.

Cu Zn

(a) Fill in the appropriate symbols in the diagram below so that it represents a particle-level diagram of a solid brass alloy that is 70 mole percent copper and 30 mole percent zinc.



(b) Should this brass alloy be classified as an interstitial alloy or a substitutional alloy? Justify your answer.

4. The following information was collected for four different solids, labeled A through D.

Solid	Physical Appearance	Melting Point	Conductivity	Solubility
A	white crystalline solid	80°C	nonelectrolyte	slightly soluble in H_2O (30 mg/L)
B	gray crystalline solid	1414°C	nonelectrolyte	insoluble in H_2O
C	white crystalline solid	770°C	conducts electricity when dissolved in water	very soluble in H_2O (344 g/L)
D	silvery-white crystalline solid	1455°C	conducts electricity as a solid	insoluble in H_2O

(a) Based on this information, classify each of the four substances into one of the following: metallic, ionic, covalent network, molecular

A _____ C _____

B _____ D _____

(b) The identity of the four solids are the following (in no particular order): silicon (Si), nickel (Ni), naphthalene ($C_{10}H_8$), & potassium chloride (KCl) Write the most likely identity for each substance.

A _____ C _____

B _____ D _____

CHAPTER 13 – 14 PRACTICE QUIZ

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

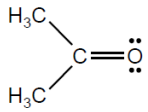
←Linked at 0:00

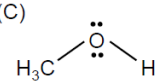
Ion	Ionic Radius (pm)
Na^+	116
Mg^{2+}	86
K^+	152
Ca^{2+}	114

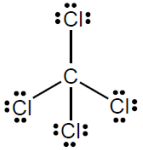
1. Based on Coulomb's law and the information in the table above, which of the following cations is most likely to have the strongest interaction with an adjacent water molecule in aqueous solution?

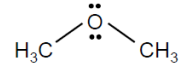
(A) Na^+ (B) Mg^{2+} (C) K^+ (D) Ca^{2+}

2. Which of the following molecules is least soluble in water?

(A) 

(C) 

(B) 

(D) 

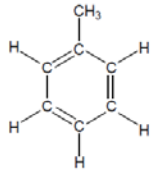
3. One reason that could explain why silver chloride (AgCl) is insoluble in water is

(A) the London dispersion forces between water molecules are very weak

(B) the ion-dipole forces between Ag^+ ions and water molecules are very strong

(C) the ionic bonds between Ag^+ ions and Cl^- ions are very strong

(D) the covalent bonds between H atoms and O atoms are very strong



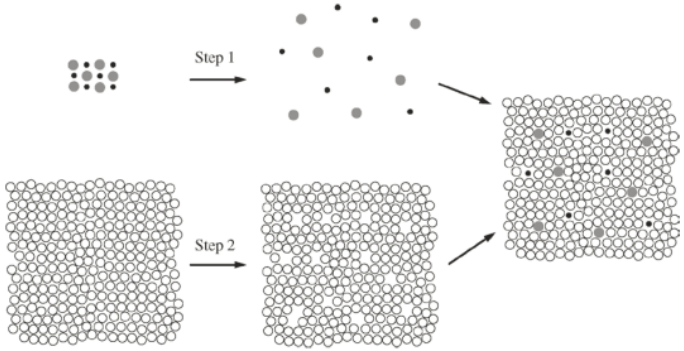
4. The structural formula of toluene (C_7H_8) is shown above. Toluene has a rather low solubility in water (0.52 g/L @ 20°C). Which of the following best describes the intermolecular forces of attraction between water and toluene?

(A) Toluene is nonpolar, so there are no attractive forces between toluene and water.

(B) The H atoms in toluene form weak hydrogen bonds with the O atoms in water.

(C) Ion-dipole forces are formed between the pi bonds of toluene and polar water molecules.

(D) There are London dispersion interactions between toluene and water.



5. The dissolution of an ionic solute in a polar solvent can be imagined as occurring in three steps, as shown in the figure above. In step 1, the separation between ions in the solute is greatly increased, just as will occur when the solute dissolves in the polar solvent. In step 2, the polar solvent is expanded to make spaces that the ions will occupy. In the last step, the ions are inserted into the spaces in the polar solvent. Which of the following best describes the enthalpy change, ΔH, for each step?

(A) All three steps are endothermic.

(B) All three steps are exothermic.

(C) Steps 1 and 2 are endothermic, and the final step is exothermic.

(D) Steps 1 and 2 are exothermic, and the final step is endothermic.

6. Which of the following substances has the greatest solubility in water?

(A) C_2H_5OH

(B) $C_{10}H_{21}OH$

(C) C_5H_{12}

(D) CCl_4

7. When most gases dissolve in water, the process is normally exothermic. Which of the following statements best supports this fact?

(A) The solubility of gases in water tends to increase as the temperature is increased.

(B) Energy is released when solvent–solvent interactions are broken.

(C) Separation of solute particles from each other requires little or no energy.

(D) Most gases form strong covalent bonds when they react with water.

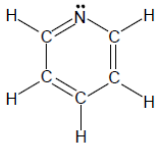
8. Which of the following conditions would maximize the solubility of O_2 in water?

	Partial Pressure of O_2 (atm)	Temperature (°C)
(A)	0.5 atm	5°C
(B)	5 atm	5°C
(C)	0.5 atm	50°C
(D)	5 atm	50°C

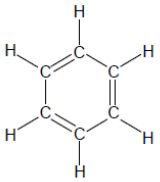
CHAPTER 13 – 14 PRACTICE QUIZ

FREE RESPONSE – CALCULATOR IS ALLOWED

←Linked at 25:11



pyridine



benzene

1. The structures of pyridine (C_5H_5N) and benzene (C_6H_6) are shown above.

   (a) Identify all of the types of intermolecular attractive forces that could exist between the solute and solvent for each of the following mixtures. Assume that water is the solvent.

Mixture	Types of intermolecular attractive forces that could exist between the solute and the solvent
pyridine and water	
benzene and water	

   (b) Which substance, pyridine or benzene, should have a greater solubility in water?

   (c) Justify your answer to part (b) by giving a specific reason for the difference in the strength of the intermolecular attractive forces mentioned in part (a).

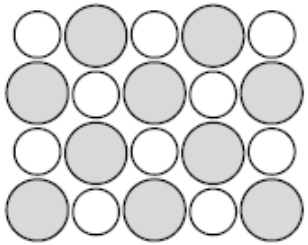
   (d) In the box below, draw one molecule of water and one molecule of pyridine.
   Draw a dashed line (----------) to indicate the strongest type of intermolecular attractive force that exists between the two molecules.
   Each end of the dashed line should be connected to a specific atom on each molecule, so that the attractive force between the molecules is indicated correctly.

CHAPTER 4 (Sections 4.1 – 4.4) PRACTICE QUIZ

FREE RESPONSE (CALCULATOR IS ALLOWED)

←Linked at 12:54

H_2O molecule

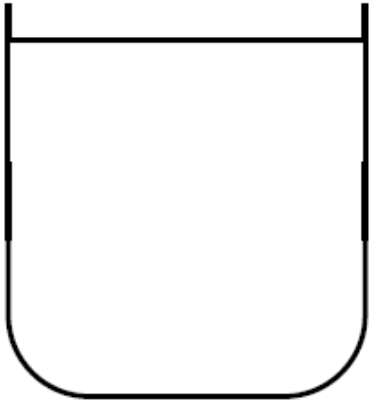


LiCl crystal

1. The structures of a water molecule and a crystal of LiCl(*s*) are represented above. A student prepares a solution by dissolving 1 g LiCl into 100 mL of water.

   (a) In the space provided below, show the interactions of the components of LiCl(*aq*) by making a drawing that represents the different particles present in the solution. You should base the particles in your drawing on the particles in the representations above. Include only one formula unit of LiCl and no more than ten molecules of water. Your drawing must include the following details.

   - identity of the ions (symbol and charge)
   - the arrangement and proper orientation of the particles in solution

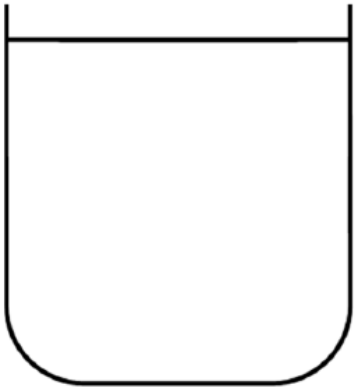


LiCl(*aq*)

   (b) Is LiCl(*aq*) classified as a strong electrolyte, a weak electrolyte, or a nonelectrolyte? Justify your prediction with an explanation that includes information about the drawing that you made in part (a).

2. Atoms of hydrogen, carbon, and oxygen are shown as follows. (H) (C) (O)

(a) In the space provided below, show what happens when two molecules of methanol (CH_3OH) are dissolved completely into water. You should use the particles in the representations above to help you draw the particle diagram for $CH_3OH(aq)$. You do not have to draw any water molecules in your diagram.



$CH_3OH(aq)$

(b) Is $CH_3OH(aq)$ classified as a strong electrolyte, a weak electrolyte, or a nonelectrolyte? Justify your prediction with an explanation that includes information about the drawing that you made in part (a).