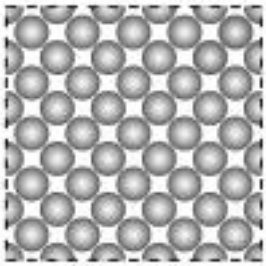
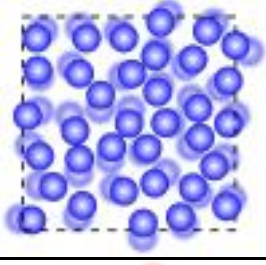
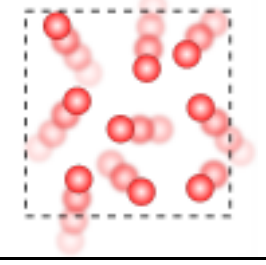


CHE 107 Exam 1 Spring 2016

Your Name: _____ Your ID: _____

Question #: 1

Molecular View	State	Density	Shape	Volume	Strength of Intermolecular Forces
	solid	high	definite	definite	<u>1</u> [strong, weak]
	liquid	high	indefinite	<u>2</u> [definite, indefinite]	moderate
	gas	<u>3</u> [high, low]	indefinite	indefinite	<u>4</u> [strong, weak]

1. _____

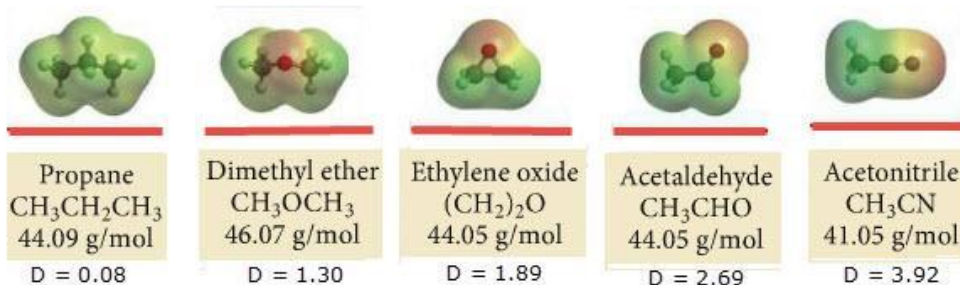
2. _____

3. _____

4. _____

Question #: 2

Select the true statement based on this image. D is the dipole moment in Debye units.



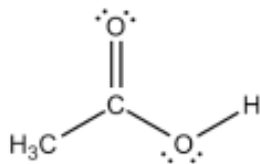
- A. Of the five listed compounds, only propane (CH₃CH₂CH₃) has intermolecular dispersion forces.
- B. Since all compounds have about the same molar mass, they have about the same boiling point.
- C. Acetonitrile has the greatest intermolecular dispersion forces.
- D. The sum of dispersion forces and dipole-dipole attractions gives acetonitrile the strongest intermolecular attractions.

Question #: 3

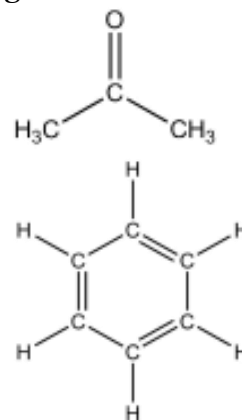
Select **all** of the liquids in which there is intermolecular hydrogen bonding.

- A. a solution of NH₃ in H₂O

- B. pure acetic acid



- C. pure acetone



- D. pure benzene

Question #: 4

For the following liquids at the indicated temperatures, 1 (A, B, C or D) has the **highest** viscosity and 2 (A, B, C or D) has the **lowest** viscosity.

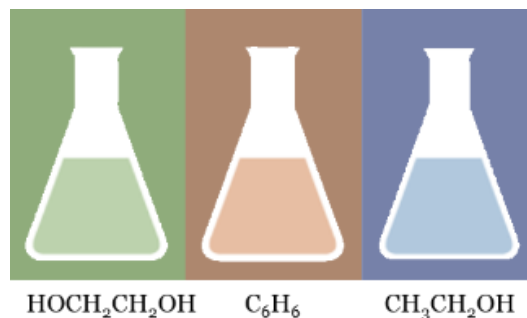
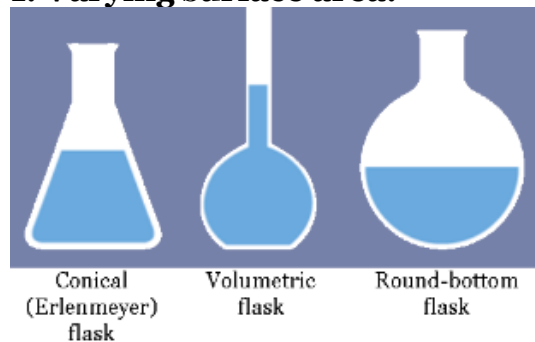
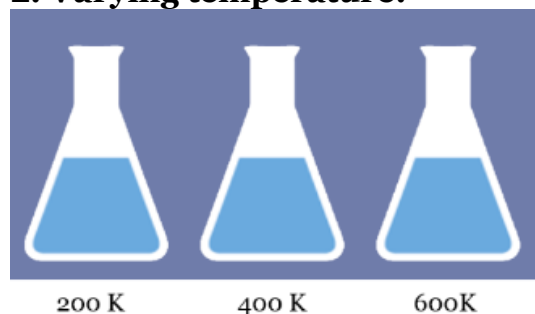
A	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	5 °C
B	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	30 °C
C	CH ₃ CH ₂ CH ₂ CH ₂ OH	5 °C
D	CH ₃ CH ₂ CH ₂ CH ₂ OH	30 °C

1. _____

2. _____

Question #: 5

Three sets of containers are shown below with their differences noted (assume all other parameters are identical). Which container from each set will have the **lowest rate of vaporization**?

1. Varying surface area:**2. Varying temperature:****3. Varying intermolecular forces:**

- A. 1. Round-bottom flask
2. 600 K
3. C₆H₆

- B. 1. Volumetric flask
2. 600 K
3. CH₃CH₂OH

- C. 1. Volumetric flask
2. 200 K
3. HOCH₂CH₂OH

- D. 1. Conical (Erlenmeyer) flask
2. 400 K
3. HOCH₂CH₂OH

Question #: 6

The normal boiling point of acetone is 56.1 °C. What is acetone's boiling point at 655 torr? The heat of vaporization, ΔH_{vap} , of acetone is 29.1 kJ/mol.

- A. 51.6 °C
B. 315 °C
C. 56.0 °C
D. 16.6 °C

Question #: 7

Which of the following statements is **true** about the critical point in a phase diagram?

- A. A liquid can exist above the critical temperature.
- B. Only a supercritical fluid exists above the critical point.
- C. The critical pressure is the pressure below which a solid is stable.
- D. The critical point is the point at which all three phases of matter are in equilibrium.

Question #: 8

Select **all** of the **true** statement(s) below.

- A. Sublimation is the phase change from liquid to gas.
- B. Fusion is an endothermic process.
- C. Sublimation is an exothermic process.
- D. The heat of vaporization (ΔH_{vap}) is greater than the heat of fusion (ΔH_{fus}) for a substance.

Question #: 9

A handful of snowflakes containing 1.20 moles of water sublimates to water vapor at 0 °C. How much heat energy was required?

At 0 °C, $\Delta H_{\text{fus}} = 6.02 \text{ kJ/mol}$ and $\Delta H_{\text{vap}} = 45.1 \text{ kJ/mol}$.



- A. 5.55 kJ
- B. 61.3 kJ
- C. 47.2 kJ
- D. 77.4 kJ

Question #: 10

How much energy is required to convert 15.0 g (0.832 mol) of $\text{H}_2\text{O}(s)$ at $-20 \text{ }^\circ\text{C}$ to $\text{H}_2\text{O}(l)$ at $20 \text{ }^\circ\text{C}$?

melting point = $0.00 \text{ }^\circ\text{C}$

boiling point = $100.0 \text{ }^\circ\text{C}$

$\Delta H_{\text{fus}} = 6.02 \text{ kJ/mol}$

$\Delta H_{\text{vap}} = 40.7 \text{ kJ/mol}$

C_s of $\text{H}_2\text{O}(s) = 2.09 \text{ J/g }^\circ\text{C}$

C_s of $\text{H}_2\text{O}(l) = 4.18 \text{ J/g }^\circ\text{C}$

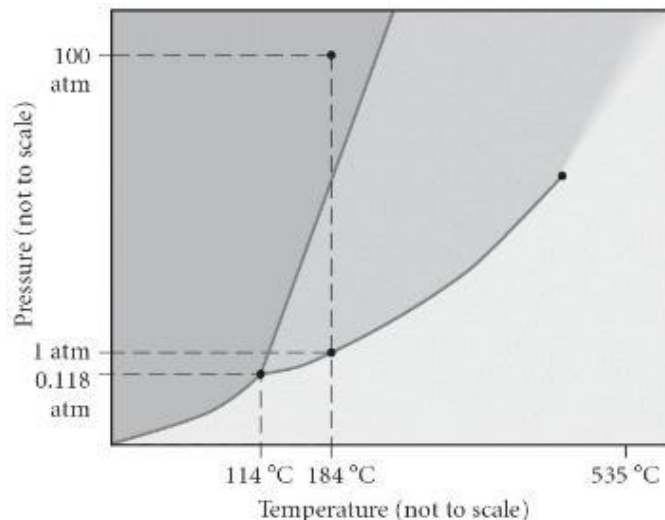
C_s of $\text{H}_2\text{O}(g) = 2.01 \text{ J/g }^\circ\text{C}$

- A. 6.89 kJ
- B. 1860 kJ
- C. 14.2 kJ
- D. 26.9 kJ

Question #: 11

Consider the phase diagram shown below. At 1 atm of pressure, what phase changes occur as the temperature is raised from 100 °C to 500 °C?

- A. condensation followed by vaporization
- B. sublimation followed by deposition
- C. fusion followed by vaporization
- D. vaporization followed by deposition



Question #: 12

Fill in the appropriate number of atoms per unit cell for the following crystalline atomic solids.

A body-centered cubic unit cell contains 1 atom(s) per unit cell.

A simple cubic unit cell contains 2 atom(s) per unit cell.

A face-centered cubic unit cell contains 3 atom(s) per unit cell.

1. _____

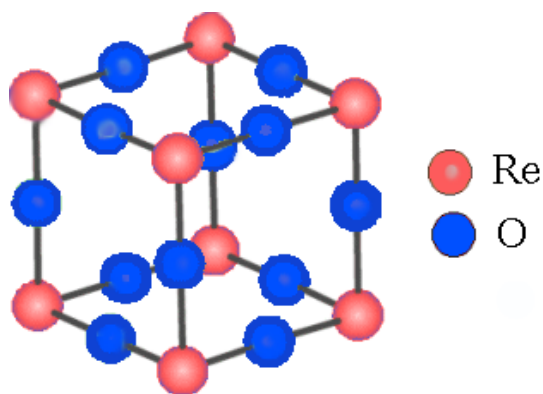
2. _____

3. _____

Question #: 13

Determine the formula for the rhenium oxide shown. Rhenium ions (red circles) are located on unit cell corners. Oxide ions (blue circles) are located on unit cell edges.

- A. Re_2O_3
- B. Re_3O
- C. ReO
- D. ReO_3



Question #: 14

Vanadium crystallizes in a body-centered cubic unit cell with a density 6.0 g/cm^3 . Calculate the edge length of the unit cell.

- A. $8.1 \times 10^{-24} \text{ cm}$
 - B. $3.0 \times 10^{-8} \text{ cm}$
 - C. $5.3 \times 10^{-12} \text{ cm}$
 - D. $7.1 \times 10^{-9} \text{ cm}$
-

Question #: 15

Which of the following is a **molecular solid**?

- A. Cu
 - B. NH_4NO_3
 - C. Xe
 - D. I_2
-

Question #: 16

According to band theory, a material with a **large** energy gap between its valence band and conduction band is a(n) 1 .

1. _____
-

Question #: 17

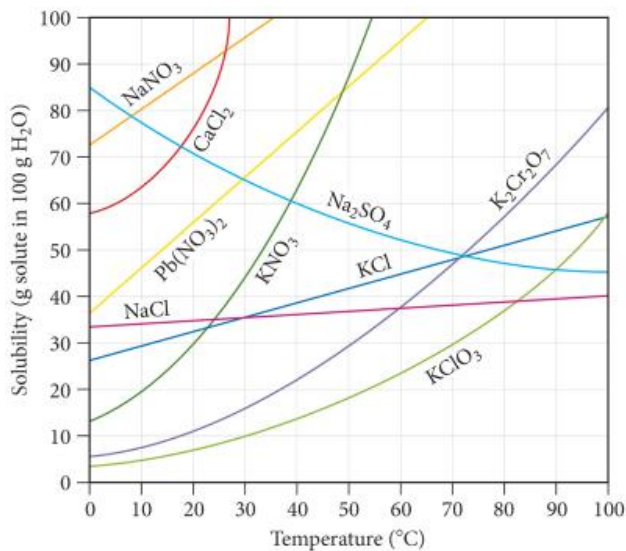
The liquids CCl_4 and C_6H_6

- A. are not miscible because they cannot form hydrogen bonds with one another.
 - B. are not miscible because they are not identical, so the intermolecular interactions in the liquids are not of similar type and magnitude.
 - C. are miscible because they are both polar molecules.
 - D. are miscible because intermolecular interactions in the liquids are of similar type and magnitude.
-

Question #: 18

Based on the information provided by the figure below, 8.7 g of $\text{Pb}(\text{NO}_3)_2$ dissolved in $20.0 \text{ g H}_2\text{O}$ at 30°C forms a(n) _____ solution.

- A. saturated
- B. supersaturated
- C. unsaturated
- D. dynamic



Question #: 19

 1 [CH₃OH, C₆H₆, or NH₃] is insoluble in water because the water-solute interactions are much 2 [$>$ or $<$] water-water plus solute-solute interactions. Enter the formula without subscripts.

1. _____

2. _____

Question #: 20

The solubility of KNO₃ in water is 316 g/L at 20 °C. Which statement is **true**?

- A. A solution containing 340 g of KNO₃ in 1 L of water at 20 °C is in a state of dynamic equilibrium.
 - B. If an additional 5 g of KNO₃ are added to a solution containing 320 g of KNO₃ in 1 L of water at 20 °C, the additional KNO₃ will dissolve.
 - C. A solution containing 302 g of KNO₃ in 1 L of water at 20 °C is saturated.
 - D. A solution containing 335 g of KNO₃ in 1 L of water at 20 °C is supersaturated.
-

Question #: 21

At 25 °C and a partial pressure of 0.020 atm NH₃, the concentration of ammonia in water is 1.16 M. What partial pressure of ammonia is required to **increase** the concentration of dissolved NH₃ to 2.00 M at 25 °C?

- A. 0.016 atm
 - B. 0.028 atm
 - C. 0.042 atm
 - D. 0.034 atm
-

Question #: 22

A 0.11 *m* aqueous solution of sucrose (C₁₂H₂₂O₁₁, 342.30 g/mol) is 1 **percent by mass** sucrose.

Do not include % with your answer.

1. _____

Question #: 23

The molality of a solution prepared by dissolving 15 grams of sodium bromide in 85.0 grams of water is 1 *m*.

Enter your answer to two significant figures, without units and **not** in scientific notation.

1. _____

Question #: 24

A 1.00 L sample of water contains 0.0036 g of Cl^- ions and has a density of 1.02 g/mL. What is the concentration of chloride ions in ppm?

1 ppm

Report your answer to 2 significant figures and do not include units.

1. _____

Question #: 25

What is the **molarity** of a 15.3 *m* NH_4NO_3 (80.05 g/mol) solution with a density of 1.252 g/mL?

A. 8.61 M

B. 12.7 M

C. 5.12 M

D. 17.9 M

Question #: 26

For each of the following solutes, enter the expected van't Hoff factor as a whole number (integer).

NaF 1

MgSO_4 2

K_2SO_3 3

$\text{C}_6\text{H}_{12}\text{O}_6$ (glucose) 4

1. _____

2. _____

3. _____

4. _____

Question #: 27

What is the vapor pressure of a solution at 25 °C that contains 940 g of fructose ($\text{C}_6\text{H}_{12}\text{O}_6$, 180 g/mol, nonvolatile) in 250 g of water?

The vapor pressure of pure water is 24 torr at 25 °C.

1 torr

Report your answer to 2 significant figures and do not include units.

1. _____

Question #: 28

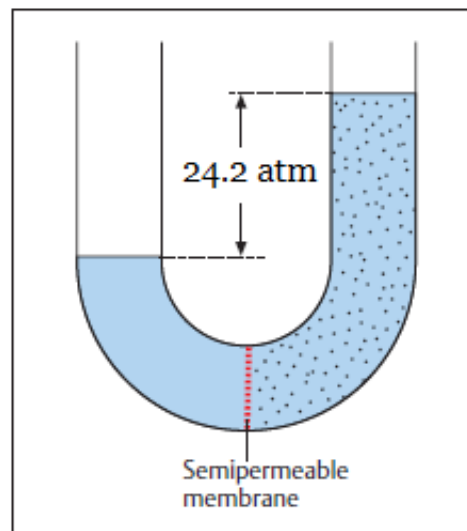
What is the boiling point of a solution of 10.0 g NaCl (58.44 g/mol) in 83.0 g H₂O?
 $K_b(\text{H}_2\text{O}) = 0.512 \text{ }^\circ\text{C}/m$

- A. 108 °C
- B. 101 °C
- C. 98.0 °C
- D. 92.0 °C

Question #: 29

What is the molarity of a Na₃PO₄ solution that exerts an osmotic pressure of 24.2 atm at 298 K?

- A. 1.18 M
- B. 0.872 M
- C. 0.624 M
- D. 0.247 M



Question #: 30

Of the aqueous solutions below, solution 1 (A, B, or C) has the highest boiling point and solution 2 (A, B, or C) has the lowest boiling point.

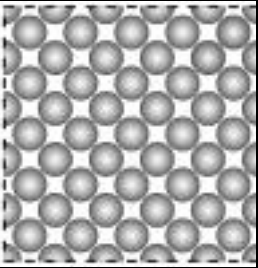
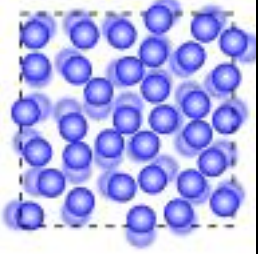
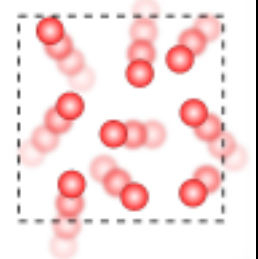
- A. 0.02 *m* CaCl₂
- B. 0.01 *m* NaBr
- C. 0.01 *m* Na₃PO₄

1. _____

2. _____

CHE 107 Exam 1 Spring 2016

Question #: 1

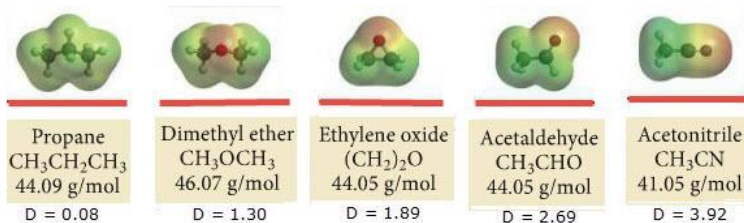
Molecular View	State	Density	Shape	Volume	Strength of Intermolecular Forces
	solid	high	definite	definite	<u>1</u> [strong, weak]
	liquid	high	indefinite	<u>2</u> [definite, indefinite]	moderate
	gas	<u>3</u> [high, low]	indefinite	indefinite	<u>4</u> [strong, weak]

1. Strong|strong|
2. definite|definite|
3. low|lo|Low|Lo|
4. weak|Weak|week|Week|

Question #: 2

Select the true statement based on this image. D is the dipole moment in Debye units.

- Of the five listed compounds, only propane ($\text{CH}_3\text{CH}_2\text{CH}_3$) has intermolecular dispersion forces.
- Since all compounds have about the same molar mass, they have about the same boiling point.
- Acetonitrile has the greatest intermolecular dispersion forces.
- D. The sum of dispersion forces and dipole-dipole attractions gives acetonitrile the strongest intermolecular attractions.

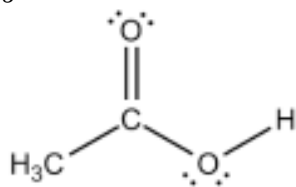


Question #: 3

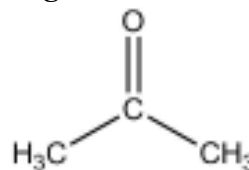
Select **all** of the liquids in which there is intermolecular hydrogen bonding.

✓ A. a solution of NH_3 in H_2O

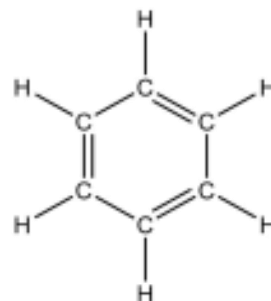
✓ B. pure acetic acid



C. pure acetone



D. pure benzene



Question #: 4

For the following liquids at the indicated temperatures, 1 (A, B, C or D) has the **highest** viscosity and 2 (A, B, C or D) has the **lowest** viscosity.

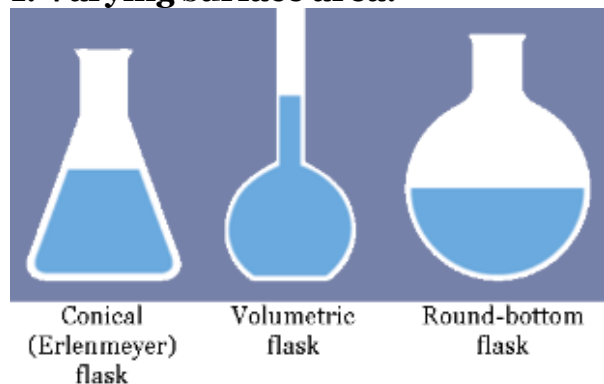
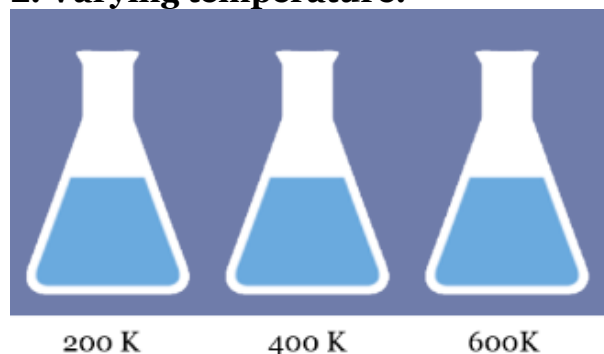
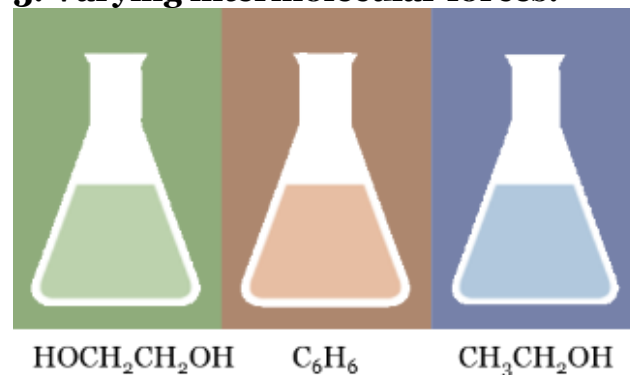
A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	5°C
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	30°C
C	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	5°C
D	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	30°C

1. C|C.|c|c.|

2. B|B.|b|b.|

Question #: 5

Three sets of containers are shown below with their differences noted (assume all other parameters are identical). Which container from each set will have the **lowest rate of vaporization**?

1. Varying surface area:**2. Varying temperature:****3. Varying intermolecular forces:**

- A. 1. Round-bottom flask
2. 600 K
3. C₆H₆

- B. 1. Volumetric flask
2. 600 K
3. CH₃CH₂OH

- ✓ C. 1. Volumetric flask
2. 200 K
3. HOCH₂CH₂OH

- D. 1. Conical (Erlenmeyer) flask
2. 400 K
3. HOCH₂CH₂OH

Question #: 6

The normal boiling point of acetone is 56.1 °C. What is acetone's boiling point at 655 torr? The heat of vaporization, ΔH_{vap} , of acetone is 29.1 kJ/mol.

- ✓ A. 51.6 °C
B. 315 °C
C. 56.0 °C
D. 16.6 °C

Question #: 7

Which of the following statements is **true** about the critical point in a phase diagram?

- A. A liquid can exist above the critical temperature.
- ✓ B. Only a supercritical fluid exists above the critical point.
- C. The critical pressure is the pressure below which a solid is stable.
- D. The critical point is the point at which all three phases of matter are in equilibrium.

Question #: 8

Select **all** of the **true** statement(s) below.

- A. Sublimation is the phase change from liquid to gas.
- ✓ B. Fusion is an endothermic process.
- C. Sublimation is an exothermic process.
- ✓ D. The heat of vaporization (ΔH_{vap}) is greater than the heat of fusion (ΔH_{fus}) for a substance.

Question #: 9

A handful of snowflakes containing 1.20 moles of water sublimates to water vapor at 0 °C. How much heat energy was required? At 0 °C, $\Delta H_{\text{fus}} = 6.02 \text{ kJ/mol}$ and $\Delta H_{\text{vap}} = 45.1 \text{ kJ/mol}$.

- A. 5.55 kJ
- ✓ B. 61.3 kJ
- C. 47.2 kJ
- D. 77.4 kJ



Question #: 10

How much energy is required to convert 15.0 g (0.832 mol) of $\text{H}_2\text{O}(s)$ at $-20 \text{ }^\circ\text{C}$ to $\text{H}_2\text{O}(l)$ at $20 \text{ }^\circ\text{C}$?

melting point = $0.00 \text{ }^\circ\text{C}$

boiling point = $100.0 \text{ }^\circ\text{C}$

$\Delta H_{\text{fus}} = 6.02 \text{ kJ/mol}$

$\Delta H_{\text{vap}} = 40.7 \text{ kJ/mol}$

C_s of $\text{H}_2\text{O}(s) = 2.09 \text{ J/g }^\circ\text{C}$

C_s of $\text{H}_2\text{O}(l) = 4.18 \text{ J/g }^\circ\text{C}$

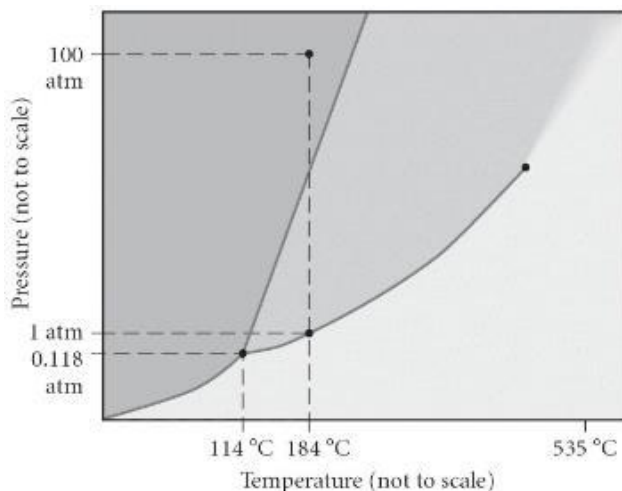
C_s of $\text{H}_2\text{O}(g) = 2.01 \text{ J/g }^\circ\text{C}$

- ✓ A. 6.89 kJ
- B. 1860 kJ
- C. 14.2 kJ
- D. 26.9 kJ

Question #: 11

Consider the phase diagram shown below. At 1 atm of pressure, what phase changes occur as the temperature is raised from 100 °C to 500 °C?

- A. condensation followed by vaporization
- B. sublimation followed by deposition
- ✓ C. fusion followed by vaporization
- D. vaporization followed by deposition



Question #: 12

Fill in the appropriate number of atoms per unit cell for the following crystalline atomic solids.

A body-centered cubic unit cell contains 1 atom(s) per unit cell.

A simple cubic unit cell contains 2 atom(s) per unit cell.

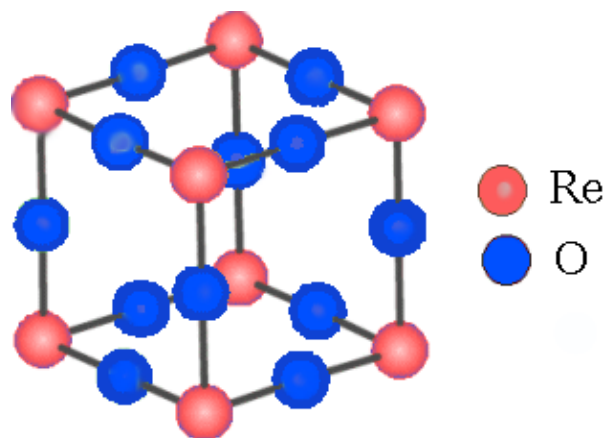
A face-centered cubic unit cell contains 3 atom(s) per unit cell.

1. 2|two|to|too|
2. 1|one|on|
3. 4|four|for|fore|

Question #: 13

Determine the formula for the rhenium oxide shown below. Rhenium ions (red circles) are located on unit cell corners. Oxide ions (blue circles) are located on unit cell edges.

- A. Re_2O_3
- B. Re_3O
- C. ReO
- ✓ D. ReO_3



Question #: 14

Vanadium crystallizes in a body-centered cubic unit cell with a density 6.0 g/cm³. Calculate the edge length of the unit cell.

- A. 8.1×10^{-24} cm
- ✓ B. 3.0×10^{-8} cm
- C. 5.3×10^{-12} cm
- D. 7.1×10^{-9} cm

Question #: 15

Which of the following is a **molecular solid**?

- A. Cu
- B. NH_4NO_3
- C. Xe
- ✓ D. I_2

Question #: 16

According to band theory, a material with a **large** energy gap between its valence band and conduction band is a(n) 1 .

1. insulator|insultor|insulatore|ensulator|Insulator|

Question #: 17

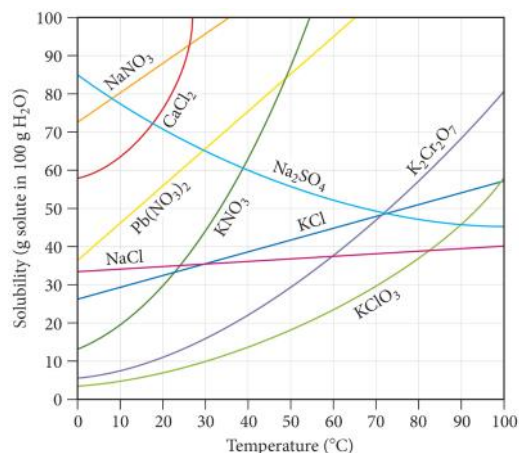
The liquids CCl_4 and C_6H_6

- A. are not miscible because they cannot form hydrogen bonds with one another.
- B. are not miscible because they are not identical, so the intermolecular interactions in the liquids are not of similar type and magnitude.
- C. are miscible because they are both polar molecules.
- ✓ D. are miscible because intermolecular interactions in the liquids are of similar type and magnitude.

Question #: 18

Based on the information provided by the figure below, 8.7 g of $\text{Pb}(\text{NO}_3)_2$ dissolved in 20.0 g H_2O at 30 °C forms a(n) _____ solution.

- A. saturated
- B. supersaturated
- ✓ C. unsaturated
- D. dynamic



Question #: 19

1 [CH_3OH , C_6H_6 , or NH_3] is insoluble in water because the water-solute interactions are much 2 [$>$ or $<$] water-water plus solute-solute interactions. Enter the formula without subscripts.

1. C_6H_6 |benzene|
2. \leq

Question #: 20

The solubility of KNO_3 in water is 316 g/L at 20 °C. Which statement is **true**?

- A. A solution containing 340 g of KNO_3 in 1 L of water at 20 °C is in a state of dynamic equilibrium.
- B. If an additional 5 g of KNO_3 are added to a solution containing 320 g of KNO_3 in 1 L of water at 20 °C, the additional KNO_3 will dissolve.
- C. A solution containing 302 g of KNO_3 in 1 L of water at 20 °C is saturated.
- ✓ D. A solution containing 335 g of KNO_3 in 1 L of water at 20 °C is supersaturated.

Question #: 21

At 25 °C and a partial pressure of 0.020 atm NH_3 , the concentration of ammonia in water is 1.16 M. What partial pressure of ammonia is required to **increase** the concentration of dissolved NH_3 to 2.00 M at 25 °C?

- A. 0.016 atm
- B. 0.028 atm
- C. 0.042 atm
- ✓ D. 0.034 atm

Question #: 22

A 0.11 *m* aqueous solution of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$, 342.30 g/mol) is 1 **percent by mass** sucrose.

Do not include % with your answer.

1. 3.6|3.7|3.5|

Question #: 23

The molality of a solution prepared by dissolving 15 grams of sodium bromide in 85.0 grams of water is 1 *m*.

Enter your answer to two significant figures, without units and **not** in scientific notation.

1. 1.7|1.7 m|1.7m|

Question #: 24

A 1.00 L sample of water contains 0.0036 g of Cl^- ions and has a density of 1.02 g/mL. What is the concentration of chloride ions in ppm?

 1 ppm

Report your answer to 2 significant figures and do not include units.

1. 3.5|3.4|3.6|

Question #: 25

What is the **molarity** of a 15.3 *m* NH_4NO_3 (80.05 g/mol) solution with a density of 1.252 g/mL?

- ✓ A. 8.61 M
- B. 12.7 M
- C. 5.12 M
- D. 17.9 M

Question #: 26

For each of the following solutes, enter the expected van't Hoff factor as a whole number (integer).

NaF 1

MgSO₄ 2

K₂SO₃ 3

C₆H₁₂O₆ (glucose) 4

1. 2

2. 2

3. 3

4. 1

Question #: 27

What is the vapor pressure of a solution at 25 °C that contains 940 g of fructose (C₆H₁₂O₆, 180 g/mol, nonvolatile) in 250 g of water?

The vapor pressure of pure water is 24 torr at 25 °C.

1 torr

Report your answer to 2 significant figures and do not include units.

1. 17

Question #: 28

What is the boiling point of a solution of 10.0 g NaCl (58.44 g/mol) in 83.0 g H₂O?

$K_b(\text{H}_2\text{O}) = 0.512 \text{ }^\circ\text{C}/m$

A. 108 °C

✓ B. 101 °C

C. 98.0 °C

D. 92.0 °C

Question #: 29

What is the molarity of a Na₃PO₄ solution that exerts an osmotic pressure of 24.2 atm at 298 K?

A. 1.18 M

B. 0.872 M

C. 0.624 M

✓ D. 0.247 M

Question #: 30

Of the aqueous solutions below, solution 1 (A, B, or C) has the highest boiling point and solution 2 (A, B, or C) has the lowest boiling point.

A. 0.02 m CaCl₂

B. 0.01 m NaBr

C. 0.01 m Na₃PO₄

1. A|A.|a|a.|

2. B|B.|b|b.|

