# CHE 107 SU17 Exam 1

Your Name: _____   **Your ID:** _____

_____

Question #: 1

A transition from the solid phase to the gas phase requires an **<u>increase</u>** in __1__ [pressure, volume, temperature] or a **<u>reduction</u>** in __2__ [pressure, volume, temperature].
Either method results in disrupting the __3__ [intramolecular, intermolecular] forces between the particles, leading to a __4__ [more, less] dense phase.

Crystalline solid   Liquid   Gas
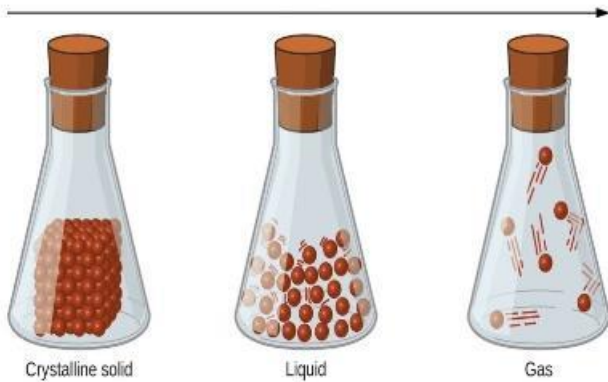
1. _____
2. _____
3. _____
4. _____

_____

Question #: 2

Rank the following in order from **lowest** to **highest** boiling point.
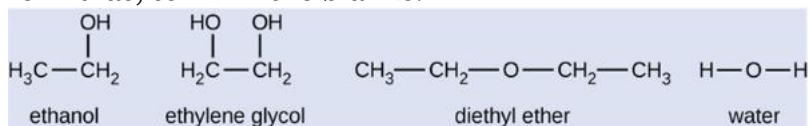
HBr, HCl, HF, HI

Lowest __1__ < __2__ < __3__ < __4__ Highest

1. _____
2. _____
3. _____
4. _____

Question #: 3

Arrange the liquids below, all at 20°C, in order of **increasing** viscosity. Use the names, not the formulas, to fill in the blanks.

OH	HO OH		
H₃C—CH₂	H₂C—CH₂	CH₃—CH₂—O—CH₂—CH₃	H—O—H
ethanol	ethylene glycol	diethyl ether	water

Lowest __1__ < __2__ < __3__ < __4__ Highest

1. _____
2. _____
3. _____
4. _____

Question #: 4

Which **two** choices will the applied process will **increase** the rate of vaporization of the liquid?

A. A beaker of water is spilled on the floor.
B. A beaker of water is cooled from 50°C to 22°C.
C. Water is poured from a conical flask to a volumetric flask.

Conical Flask   Volumetric Flask

D. The water in a beaker is heated from 50°C to 80 °C.

Question #: 5

One of the compounds that gives roses their characteristic smell is 2-phenylethanol, $C_8H_{10}O$. If the normal boiling point of 2-phenylethanol is 493 K, what temperature will **double** the vapor pressure? ΔH_{vap} = 69 kJ/mol
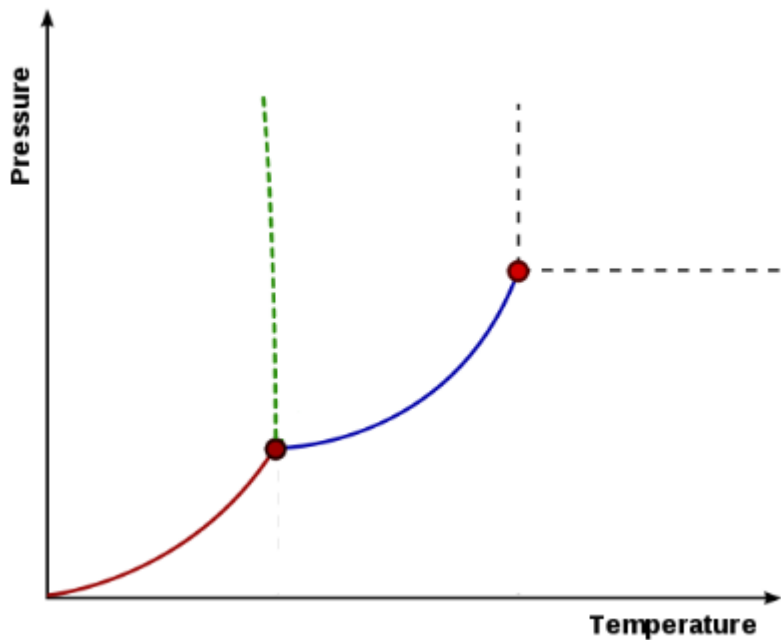
A. 514 K
B. 374 K
C. 429 K
D. 622 K

Attachment:
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Which statement is **true** about the critical point for a substance?

A. Only a gas exists above the critical temperature.
B. Only a supercritical fluid exists above the critical point.
C. The critical temperature is the temperature above which a liquid is stable.
D. The gas phase cannot exist below a substance's critical pressure.

Select the **two true** statement(s).

A. Sublimation is the phase change from solid to gas (vapor).
B. Fusion is an exothermic process.
C. Sublimation is an exothermic process.
D. Deposition is an exothermic process.

A handful of snowflakes containing 1.56 moles of water sublimes to water vapor at 0 °C. How much heat energy was required?

At 0 °C, ΔH_{fus} = 6.02 kJ/mol and ΔH_{vap} = 45.1 kJ/mol.

Ice   Water

___1___ kJ

Report your answer to the correct number of significant figures. Do **NOT** include units in your answer

1. _____

_____

How much energy is required to convert 11.5 g (0.250 mol) of liquid ethanol, $CH_3CH_2OH(l)$, at −21.6°C, to gaseous ethanol, $CH_3CH_2OH(g)$, at 78.4°C?

melting point	−114°C
boiling point	78.4°C
ΔH_{fus}	5.02 kJ/mol
ΔH_{vap}	38.6 kJ/mol
C_s of $CH_3CH_2OH(s)$	0.97 J/g·°C
C_s of $CH_3CH_2OH(l)$	2.46 J/g·°C
C_s of $CH_3CH_2OH(g)$	0.95 J/g·°C

A. 12.5 kJ

B. 8.98 kJ

C. 6.21 kJ

D. 14.2 kJ

Question #: 10

The phase change that occurs moving in a straight line from point B to point C is ___1___.
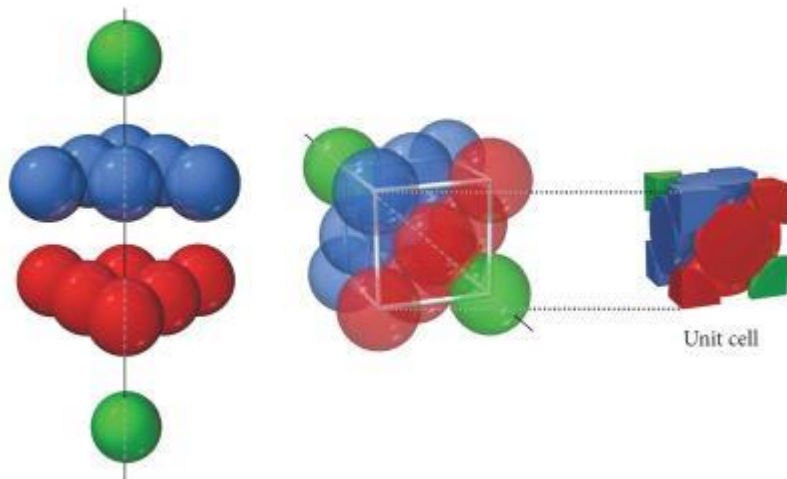[freezing, fusion, sublimation, vaporization]
The phase change that occurs moving in a straight line from point D to point C is ___2___.
[condensation, deposition, fusion, sublimation]

1. _____
2. _____

Copper (64 g/mol) crystallizes in a cubic-closest pack structure as shown below. The volume of the unit cell is 4.75×10^{-23} cm³. What is the the **density** of copper?
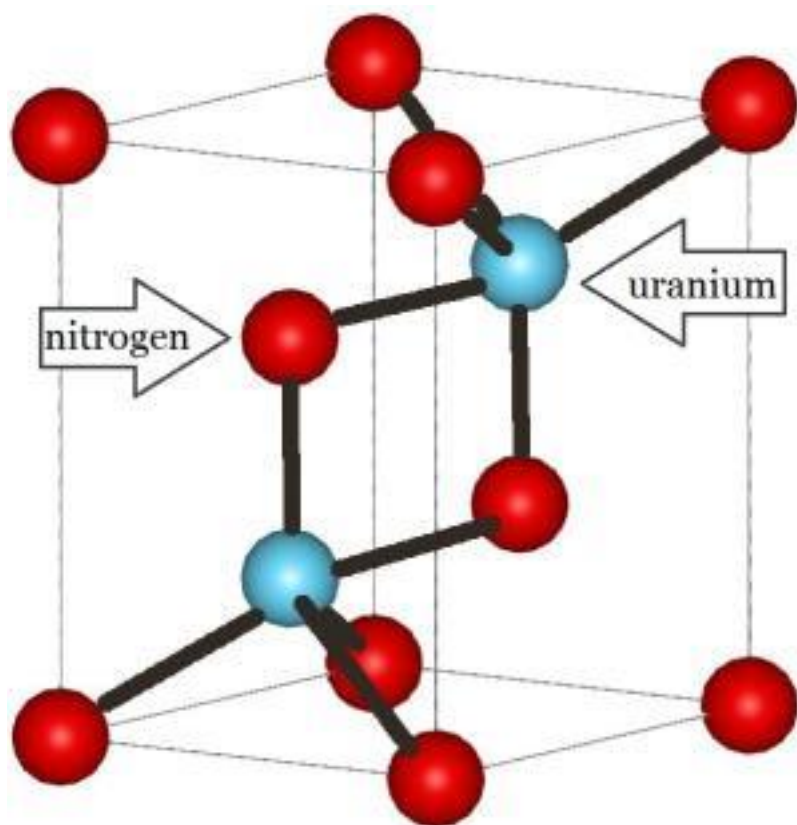

Unit cell

A. 4.49×10^{-8} g/cm³
B. 4.81 g/cm³
C. 12.6 g/cm³
D. 8.95 g/cm³

The formula of the ionic compound with the unit cell below is ___1___. Note that the blue uranium ions and two red nitride ions occupy interior positions and are contained wholly within the cubic unit cell. The remainder of the red nitride ions are located on the corners.
List the formula in the order U# N#, with the lowest whole-number coefficient for each element (even if it is 1).

1. _____

Question #: 13

Solid benzene, $C_6H_6(s)$, is a(n) __1__ [molecular, ionic, nonbonding atomic, metallic, network covalent] crystalline solid. As such, $C_6H_6(s)$ has a relatively __2__ [low, high] melting point compared to carbon nanotubes, pictured below, which are __3__ [molecular, ionic, nonbonding atomic, metallic, network covalent] crystalline solids.
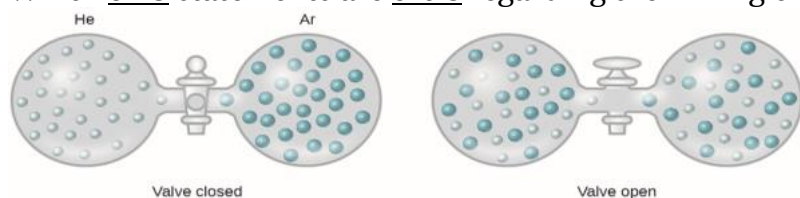
1. _____

2. _____

3. _____

Question #: 14

Which one acts as a ***p-type semiconductor***?

    A. germanium doped with indium

    B. silicon doped with arsenic

    C. germanium doped with phosphorous

    D. phosphorous doped with gallium

Which **two** statements are **true** regarding the mixing of helium and argon, as shown below?

A. Mixing is spontaneous because it lowers the potential energy of the system.
B. Helium and argon can be considered ideal gases for the purposes of this experiment because they do not experience significant intermolecular attractions.
C. Mixing is spontaneous because it increases the entropy, or energy dispersal, of the system.
D. Helium and argon do not mix spontaneously because their intermolecular forces are not similar in type or size.
E. Heat energy has to be added to the system for mixing to occur.

The liquids $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2OH$ and H_2O

A. are not miscible because they are both nonpolar molecules.
B. are not miscible because the intermolecular interactions in the liquids are not of similar type and magnitude.
C. are miscible because they are both polar molecules.
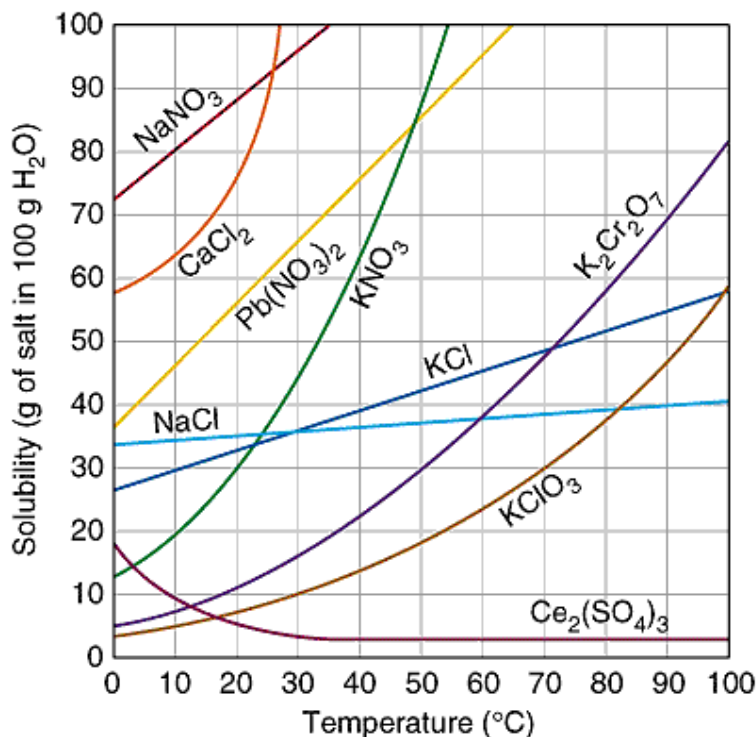D. are miscible because intermolecular interactions in the liquids are of similar type and magnitude.

An aqueous solution is saturated in both $O_2(g)$ and $C_6H_{12}O_6(aq)$ at 35 ºC, and there is some $C_6H_{12}O_6(s)$ present. If the solution is left open to the atmosphere and cooled to 15 ºC, which **two** are most likely to occur?

    A. Some $O_2(g)$ bubbles out of solution.
    B. Some $C_6H_{12}O_6(s)$ precipitates.
    C. Some $C_6H_{12}O_6(s)$ dissolves.
    D. Some $O_2(g)$ dissolves into solution.
    E. Neither the $O_2(g)$ nor the $KCl(aq)$ concentration changes.

_____

What happens when 60.0 g of KNO_3 is added to 200.0 g of water 20.0 °C?

    A. All 60.0 g of KNO_3 dissolves, resulting in an unsaturated solution.
    B. All 60.0 g of KNO_3 dissolves, resulting in a saturated solution.
    C. All 60.0 g of KNO_3 dissolves, resulting in a supersaturated solution.
    D. A portion of the 60.0 g of KNO_3 dissolves, resulting in a saturated solution with $KNO_3(s)$ remaining.

Question #: 19

The molality of a solution prepared by dissolving 18.0 grams of ammonium nitrate (NH_4NO_3, 80.0 g/mol) in 40.0 grams of water is ___1___ *m*.
Report your answer to **three** significant digits.   Do **NOT** include units in your answer.

1. _____

Question #: 20

A 1.50 kg water sample contains 0.0078 g of Zn^{2+} ions. What is the concentration of zinc in **ppm**?

A. 5.2 ppm
B. 7.2 ppm
C. 3.6 ppm
D. 1.8 ppm

Question #: 21

A 4.25 M glycerol ($C_3H_8O_3$, 92 g/mol) solution has a density of 1.195 g/mL and a molal concentration of ___1___ *m*.
Report your answer with **two** significant figures.   Do **NOT** include units in your answer.

1. _____

What is the vapor pressure of a solution of 55.8 g (0.900 mol) of ethylene glycol, a nonvolatile nonelectrolyte, in 144 g (8.00 mol) of water at 110.0 °C? The vapor pressure of pure water at 110.0 °C is 1070 torr.

A. 962 torr
B. 839 torr
C. 1020 torr
D. 1210 torr

What is the freezing point of a solution containing 21.9 g (0.0750 mol) of iron(III) carbonate, $Fe_2(CO_3)_3$, dissolved in 0.175 kg of water?
$K_f (H_2O) = 1.86 °C/m$
__1__ °C
Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1. _____

An osmotic cell with a semipermeable membrane is set up with pure water in the left chamber and 1.50 M KCl in the right chamber. What happens as the cell reaches equilbrium?

H$_2$O   1.50 M KCl

Semipermeable membrane

A. The liquid level in the left (H$_2$O) cell rises.
B. The liquid level in the right (1.50 M KCl) cell rises.
C. The levels remain the same.

Question #: 25

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 **highest freezing point**.
A. 0.01 m MgCl$_2$
B. 0.02 m KF
C. 0.01 m FeI$_4$

1. _____
2. _____

CHE 107 SU17 Exam 1 - Confidential

Your Name: _____   **Your ID:** _____

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Question #: 1

A transition from the solid phase to the gas phase requires an **increase** in __1__ [pressure, volume, temperature] or a **reduction** in __2__ [pressure, volume, temperature].
Either method results in disrupting the __3__ [intramolecular, intermolecular] forces between the particles, leading to a __4__ [more, less] dense phase.

Crystalline solid   Liquid   Gas
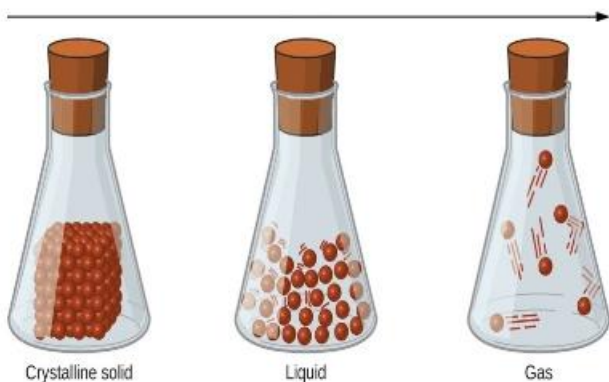
1. temperature
2. pressure
3. interrmolecular
4. less

Question #: 2

Rank the following in order from **lowest** to **highest** boiling point.

HBr, HCl, HF, HI

Lowest __1__ < __2__ < __3__ < __4__ Highest

1. HCl
2. HBr
3. HI
4. HF

Question #: 3

Arrange the liquids below, all at 20°C, in order of **increasing** viscosity. Use the names, not the formulas, to fill in the blanks.

ethanol   ethylene glycol   diethyl ether   water
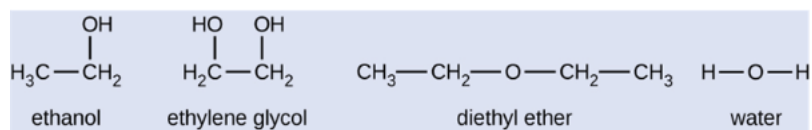
Lowest   _1_ < _2_ < _3_ < _4_   Highest

    1. diethyl ether
    2. ethanol
    3. water
    4. ethylene glycol

Question #: 4

Which **two** choices will the applied process will **increase** the rate of vaporization of the liquid?

    ✓A. A beaker of water is spilled on the floor.
    B. A beaker of water is cooled from 50°C to 22°C.
    C. Water is poured from a conical flask to a volumetric flask.

Conical   Volumetric
Flask   Flask

    ✓D. The water in a beaker is heated from 50°C to 80 °C.

Question #: 5

One of the compounds that gives roses their characteristic smell is 2-phenylethanol, $C_8H_{10}O$. If the normal boiling point of 2-phenylethanol is 493 K, what temperature will **double** the vapor pressure? ΔH_{vap} = 69 kJ/mol
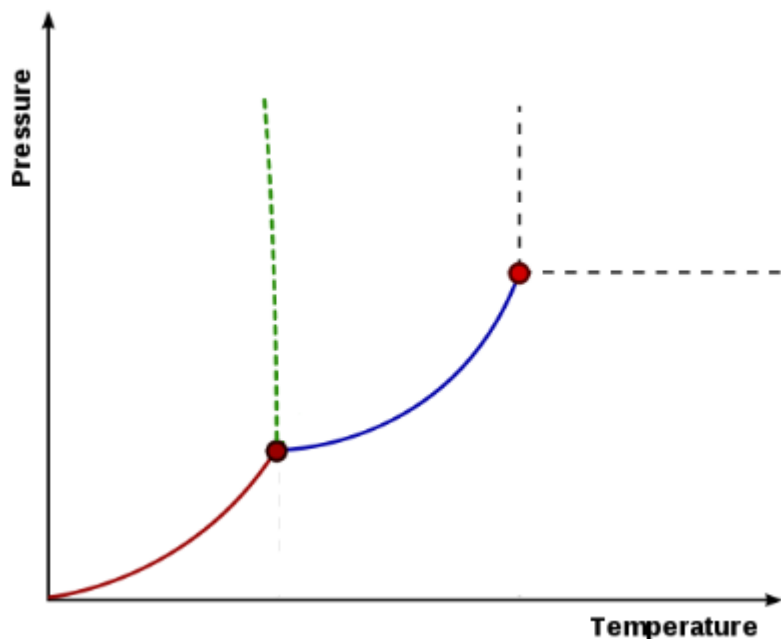
    ✓A. 514 K
    B. 374 K
    C. 429 K

D. 622 K

Question #: 6

Which statement is **true** about the critical point for a substance?

A. Only a gas exists above the critical temperature.
✓B. Only a supercritical fluid exists above the critical point.
C. The critical temperature is the temperature above which a liquid is stable.
D. The gas phase cannot exist below a substance's critical pressure.

Question #: 7

Select the **two true** statement(s).

✓A. Sublimation is the phase change from solid to gas (vapor).
B. Fusion is an exothermic process.
C. Sublimation is an exothermic process.
✓D. Deposition is an exothermic process.

Question #: 8

A handful of snowflakes containing 1.56 moles of water sublimes to water vapor at 0 °C. How much heat energy was required?

At 0 °C, ΔH_{fus} = 6.02 kJ/mol and ΔH_{vap} = 45.1 kJ/mol.

Ice   Water

__1__ kJ

Report your answer to the correct number of significant figures. Do **NOT** include units in your answer

1. 79.7

Question #: 9

How much energy is required to convert 11.5 g (0.250 mol) of liquid ethanol, $CH_3CH_2OH(l)$, at −21.6°C, to gaseous ethanol, $CH_3CH_2OH(g)$, at 78.4°C?

melting point	−114°C
boiling point	78.4°C
H_{fus}	5.02 kJ/mol
H_{vap}	38.6 kJ/mol
C_s of $CH_3CH_2OH(s)$	0.97 J/g·°C
C_s of $CH_3CH_2OH(l)$	2.46 J/g·°C
C_s of $CH_3CH_2OH(g)$	0.95 J/g·°C

✓A. 12.5 kJ
B. 8.98 kJ
C. 6.21 kJ
D. 14.2 kJ

Question #: 10

The phase change that occurs moving in a straight line from point B to point C is ___1___.
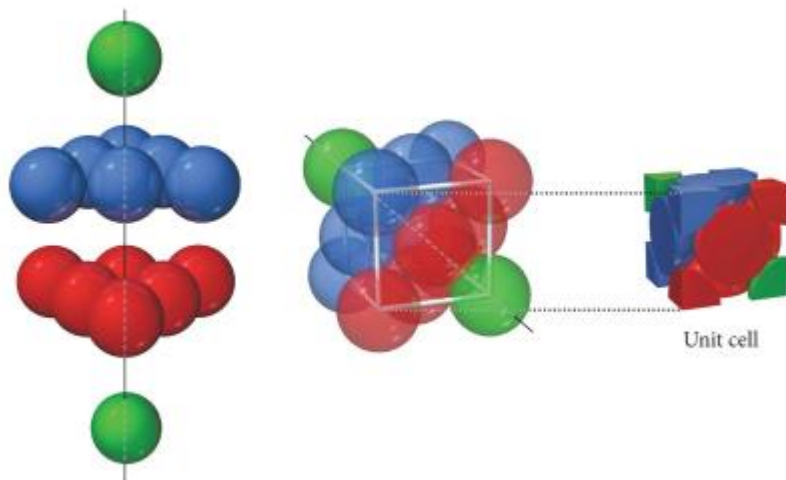[freezing, fusion, sublimation, vaporization]
The phase change that occurs moving in a straight line from point D to point C is ___2___.
[condensation, deposition, fusion, sublimation]

1. fusion
2. condensation

Question #: 11

Copper (64 g/mol) crystallizes in a cubic-closest pack structure as shown below. The volume of the unit cell is 4.75×10^{-23} cm^3. What is the the **density** of copper?

Unit cell

A. 4.49×10^{-8} g/cm^3
B. 4.81 g/cm^3
C. 12.6 g/cm^3
✓D. 8.95 g/cm^3

Question #: 12

The formula of the ionic compound with the unit cell below is ___1___ . Note that the blue uranium ions and **two red nitride ions occupy interior positions and are** contained wholly within the cubic unit cell. The remainder of the red nitride ions are located on the corners.

List the formula in the order U# N#, with the lowest whole-number coefficient for each element (even if it is 1).
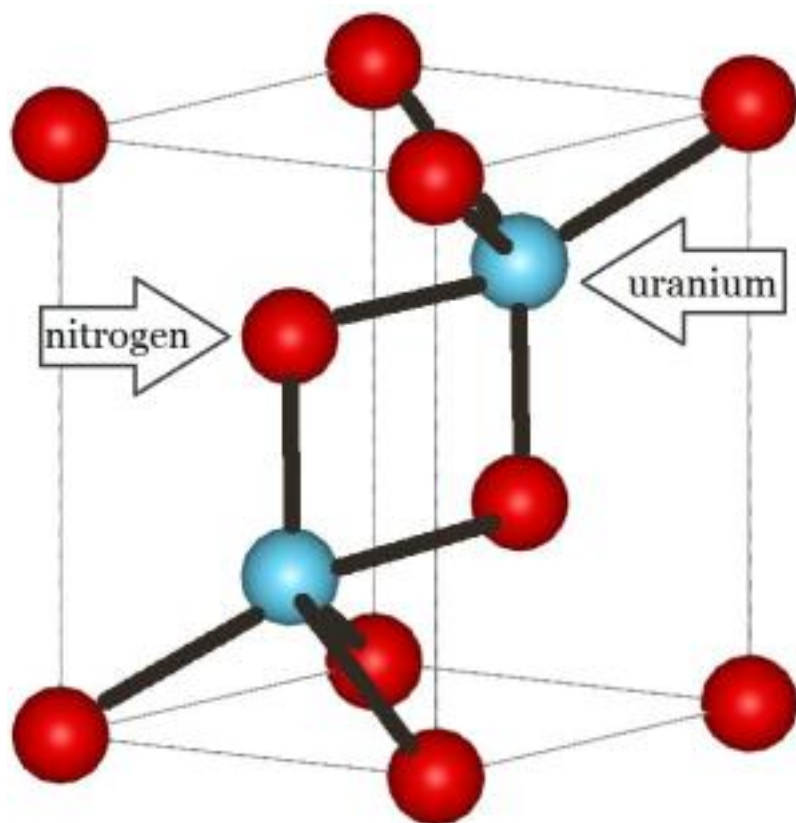
1. U2N3|U2 N3|

Question #: 13

Solid benzene, $C_6H_6(s)$, is a(n) __1__ [molecular, ionic, nonbonding atomic, metallic, network covalent] crystalline solid. As such, $C_6H_6(s)$ has a relatively __2__ [low, high] melting point compared to carbon nanotubes, pictured below, which are __3__ [molecular, ionic, nonbonding atomic, metallic, network covalent] crystalline solids.
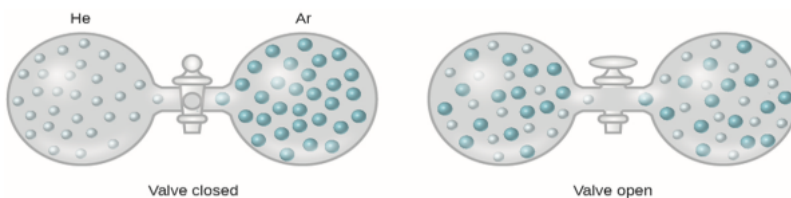
1. molecular|molecule|
2. low|lo|
3. network covalent

Which one acts as a ***p*-type semiconductor**?

- ✓A. germanium doped with indium
- B. silicon doped with arsenic
- C. germanium doped with phosphorous
- D. phosphorous doped with gallium

Which **two** statements are **true** regarding the mixing of helium and argon, as shown below?

A. Mixing is spontaneous because it lowers the potential energy of the system.
✓B. Helium and argon can be considered ideal gases for the purposes of this experiment because they do not experience significant intermolecular attractions.
✓C. Mixing is spontaneous because it increases the entropy, or energy dispersal, of the system.
D. Helium and argon do not mix spontaneously because their intermolecular forces are not similar in type or size.
E. Heat energy has to be added to the system for mixing to occur.

Question #: 16

The liquids $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2OH$ and H_2O

A. are not miscible because they are both nonpolar molecules.
✓B. are not miscible because 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 #: 17

An aqueous solution is saturated in both $O_2(g)$ and $C_6H_{12}O_6(aq)$ at 35 °C, and there is some $C_6H_{12}O_6(s)$ present. If the solution is left open to the atmosphere and cooled to 15 °C, which **two** are most likely to occur?

A. Some $O_2(g)$ bubbles out of solution.
✓B. Some $C_6H_{12}O_6(s)$ precipitates.
C. Some $C_6H_{12}O_6(s)$ dissolves.
✓D. Some $O_2(g)$ dissolves into solution.
E. Neither the $O_2(g)$ nor the KCl(aq) concentration changes.

Question #: 18

What happens when 60.0 g of KNO_3 is added to 200.0 g of water 20.0 °C?
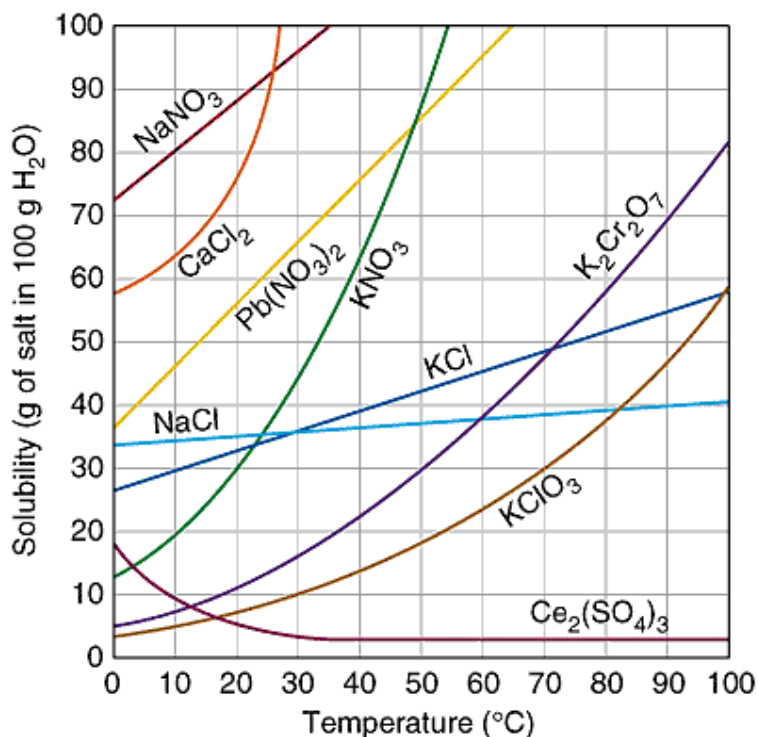
A. All 60.0 g of KNO_3 dissolves, resulting in an unsaturated solution.
✓B. All 60.0 g of KNO_3 dissolves, resulting in a saturated solution.
C. All 60.0 g of KNO_3 dissolves, resulting in a supersaturated solution.
D. A portion of the 60.0 g of KNO_3 dissolves, resulting in a saturated solution with $KNO_3(s)$ remaining.

Question #: 19

The molality of a solution prepared by dissolving 18.0 grams of ammonium nitrate (NH_4NO_3, 80.0 g/mol) in 40.0 grams of water is ___1___ m.
Report your answer to **three** significant digits. Do **NOT** include units in your answer.

1. 5.63|5.62|

Question #: 20

A 1.50 kg water sample contains 0.0078 g of Zn^{2+} ions. What is the concentration of zinc in **ppm**?

✓A. 5.2 ppm
   B. 7.2 ppm
   C. 3.6 ppm
   D. 1.8 ppm

Question #: 21

A 4.25 M glycerol ($C_3H_8O_3$, 92 g/mol) solution has a density of 1.195 g/mL and a molal concentration of __1__ m.

Report your answer with **two** significant figures. Do **NOT** include units in your answer.

   1. 5.3

Question #: 22

What is the vapor pressure of a solution of 55.8 g (0.900 mol) of ethylene glycol, a nonvolatile nonelectrolyte, in 144 g (8.00 mol) of water at 110.0 °C? The vapor pressure of pure water at 110.0 °C is 1070 torr.

   ✓A. 962 torr
   B. 839 torr
   C. 1020 torr
   D. 1210 torr

Question #: 23

What is the freezing point of a solution containing 21.9 g (0.0750 mol) of iron(III) carbonate, $Fe_2(CO_3)_3$, dissolved in 0.175 kg of water?
$K_f(H_2O) = 1.86$ °C/m
   __1__ °C
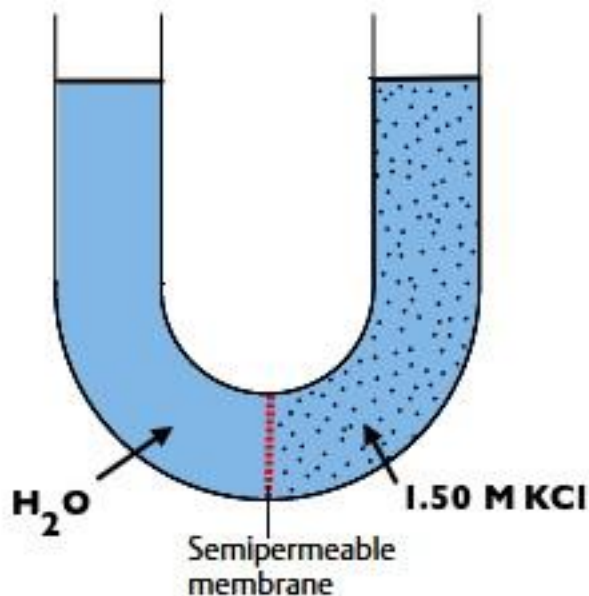
Report your answer with **three** significant figures. Do **NOT** include units in your answer.

   1. -3.99

An osmotic cell with a semipermeable membrane is set up with pure water in the left chamber and 1.50 M KCl in the right chamber. What happens as the cell reaches equilbrium?

H$_2$O   **1.50 M KCl**

Semipermeable
membrane

    A. The liquid level in the left (H$_2$O) cell rises.
  ✓B. The liquid level in the right (1.50 M KCl) cell rises.
    C. The levels remain the same.

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 **highest freezing point**.
A. 0.01 m MgCl$_2$
B. 0.02 m KF
C. 0.01 m FeI$_4$

    1. C|C.|C|C.|
    2. A|A.|a|a.|