1. Which statement correctly describes a gas?

A. The molecules of a gas are very close together, and as a consequence, the densities are low compared to the other states.

B. The distances between the molecules of a gas are far greater than the size of the molecules, and as a consequence, the densities are high compared to the other states.

C. The molecules of a gas are very close together, and as a consequence, the densities are high compared to the other states.

D. The distances between the molecules of a gas are far greater than the size of the molecules, and as a consequence, the densities are low compared to the other states.

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2. Which statement about intermolecular forces is **false**?

A. Dispersion forces exist between all molecules and atoms.

B. Dispersion forces result from the permanent, uneven distribution of electrons.

C. Dipole-dipole forces are present between all polar molecules.

D. The strength of dispersion forces increases with increasing molar mass.

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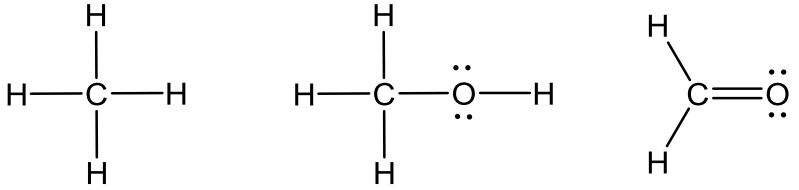
3. Consider the following three substances:



Which statement is true concerning the substances in the liquid state?

A. CH_3OH is the only substance of the three that can hydrogen bond.

B. All three substances can hydrogen bond because all substances contain hydrogen atoms.

C. CH_3OH and CH_2O both can hydrogen bond because both substances contain hydrogen and oxygen atoms.

D. None of the substances meet the criteria for hydrogen bonding.

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4. Which of the following has the compound with the **greater** viscosity listed **first**? All pairs are at the same temperature unless stated otherwise.

A. C_6H_6, H_2O

B. CH_3CH_2OH, $HOCH_2CH_2OH$

C. $CH_3CH_2CH_2CH_2CH_3$, $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

D. $H_2O(l)$ at 0 °C , $H_2O(l)$ at 100 °C

5. Into a 200 mL flask, 100 mL of a liquid is placed and the flask is stoppered. The equilibrium vapor pressure is reached

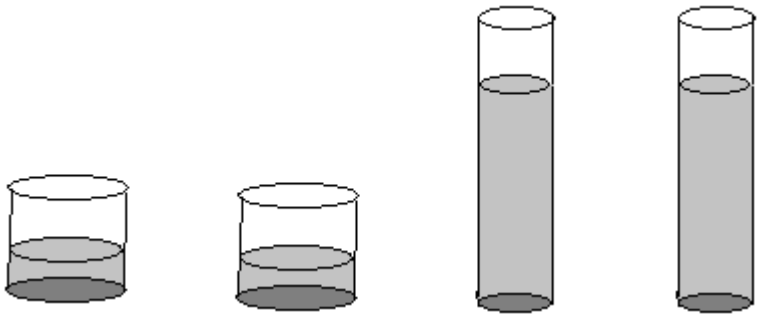
A. instantly.

B. as soon as the rate of vaporization equals the rate of condensation.

C. as long as the rate of evaporation stays greater than the rate of condensation.

D. once the rate of condensation is greater than the rate of vaporization.

6. Four containers each contain 25 mL of diethyl ether. Which container will exhibit the greatest rate of evaporation?



I	II	III	IV
Temp = 25 ˚C	50 ˚C	25 ˚C	50 ˚C

A. II

B. IV

C. II and IV have the same rate.

D. I and II have the same rate.

7. Ammonia has a normal boiling point of -33.0 °C and a heat of vaporization (ΔH_{vap}) of 23.35 kJ/mol. What is the vapor pressure of ammonia at -75.0 °C?

A. 3.67 torr
C. 548 torr
B. 49.1 torr
D. 63.5 torr

8. For a liquid in a sealed container, as the temperature increases, there is a point where the liquid and gas phases cease to exist. Which of the following statements is **false**?

A. This temperature is called the critical temperature.
B. When the phase boundary disappears, the substance is a supercritical fluid.
C. There is no temperature at which the phase boundary disappears. The above statement is therefore false.
D. At this point, the substance has properties of both liquids and gases.

9. Which of the choices below correctly completes the sentence?

Sublimation is the conversion of a _____ to a _____. The reverse process is called _____.

A. gas, liquid, deposition
C. liquid, gas, condensation
B. gas, solid, condensation
D. solid, gas, deposition

10. Which of the choices correctly matches the enthalpy values to the phase changes of mercury?

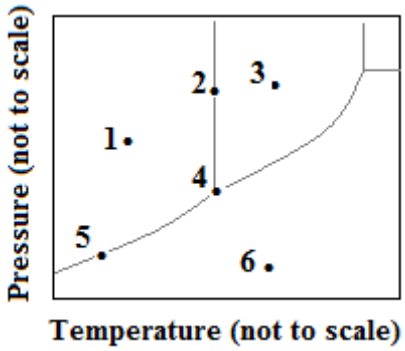
A. ΔH_{sub} = 93.3 kJ/mol, ΔH_{fus} = 2.30 kJ/mol, ΔH_{vap} = 91.0 kJ/mol
B. ΔH_{sub} = 93.3 kJ/mol, ΔH_{fus} = 91.0 kJ/mol, ΔH_{vap} = 2.30 kJ/mol
C. ΔH_{sub} = 91.0 kJ/mol, ΔH_{fus} = 2.30 kJ/mol, ΔH_{vap} = 93.3 kJ/mol
D. ΔH_{fus} = 2.30 kJ/mol, ΔH_{vap} = 91.0 kJ/mol, and ΔH_{sub} cannot be calculated from the information given.

11. How much heat is evolved in converting 15.0 g of steam at 135.0 °C to liquid water at 100.0 °C?

Specific heat, ice = 2.09 J/g·°C
Specific heat, water = 4.18 J/g·°C
Specific heat, steam = 2.01 J/g·°C
Heat of vaporization, water = 40.7 kJ/mol
Heat of fusion, water = 6.02 kJ/mol

A. 33.3 kJ
C. 1.04 kJ
B. 34.9 kJ
D. 36.2 kJ

12.



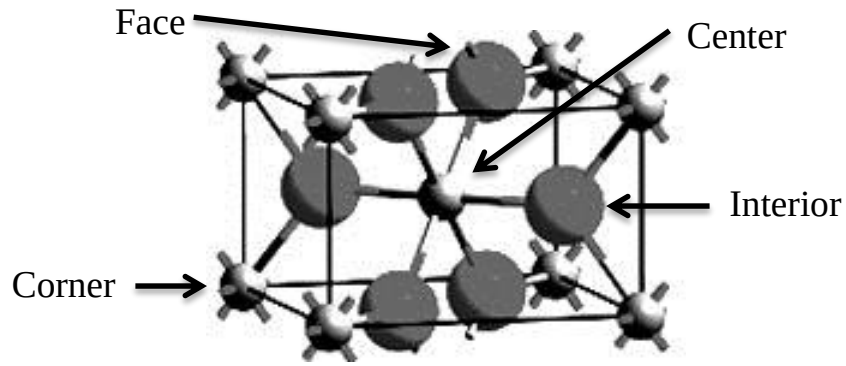
Examine the phase diagram above. Determine which of the following correctly identifies the points.

A. Point 3 is a supercritical fluid. Point 4 is the triple point.
B. Point 2 is on the liquid-vapor phase boundary. Point 6 is a gas.
C. Point 1 is a solid. Point 5 is on the solid-vapor phase boundary.
D. Point 4 is the critical point. Point 3 is a liquid.

13. Which crystal structure of a metal contains two atoms per unit cell, has a coordination number of eight, and a packing efficiency of 68%?

A. Body-centered cubic
C. Face-centered cubic
B. Simple cubic
D. Amorphous

14. The following image is a unit cell of a metal oxide. The metal is the smaller, lighter colored atom in the image. Determine the empirical formula of the metal oxide.



A. M_3O_2

B. M_2O_3

C. MO_2

D. MO_3

15. A certain metal crystallizes in a face-center cube with edge length of 0.352 nm. The mass of a single atom of this metal is 9.75×10^{-23} g. Determine the density of the metal.

A. 2.22 g/cm^3

B. 8.94 g/cm^3

C. 8.99×10^{-23} g/cm^3

D. 1.31×10^{3} g/cm^3

16. Which type of crystalline solid is characterized by low melting points and contains nonmetal atoms at lattice points of the crystal held together only by dispersion forces?

A. Metallic solids

B. Network covalent solids

C. Nonbonding atomic solids

D. Molecular solids

17. Which states of matter **<u>can never</u>** form a solution?

A. Solid and solid.

B. Solid and liquid.

C. Liquid and gas.

D. Combinations A, B and C **<u>can all</u>** form solutions.

18. Which one of the following compounds is most soluble in H_2O?

A. CH_3OH

B. $CH_3CH_2CH_2CH_2CH_2CH_2OH$

C. CCl_4

D. CBr_4

19. An unsaturated solution

A. must have more solute than solvent.

B. can dissolve more solute.

C. has more solute dissolved than predicted by the solubility.

D. has a precipitated solute in equilibrium with the dissolved solute.

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20. What is the molar solubility of nitrogen in water exposed to air when the atmospheric pressure is 1.0 atm? The mole fraction of N_2 in air is 0.78.

Henry's Law constant for N_2 in water is 6.1×10^{-3} M/atm at 25 °C.

A. 4.8×10^{-3} M

B. 6.1×10^{-3} M

C. 120 M

D. 3.9 M

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21. A solution contains 1.50 kg of NaCl in 23.0 kg of water. What is the molality of the solution?

A. 12.5 *m*

B. 0.152 *m*

C. 1.12 *m*

D. 2.37 *m*

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22. A solution is prepared by dissolving 10.55 g NaCl in enough water to produce 250.0 mL of solution. The density of the solution is 1.005 g/mL. Determine the percent by mass of the solution.

A. 4.226 %

B. 4.407 %

C. 4.240 %

D. 4.199 %

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23. A solution is 1.50 M $Ni(NO_3)_2$. Determine the mass of solute contained in 75.0 mL of solution? The molar mass of $Ni(NO_3)_2$ is 182.7 g/mol.

A. 0.110 g

B. 20.6 g

C. 9.04 g

D. 0.618 g

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24. Hydrochloric acid is sold as a 12.3 M solution with a density of 1.19 g/mL. What is the molality of the HCl solution?

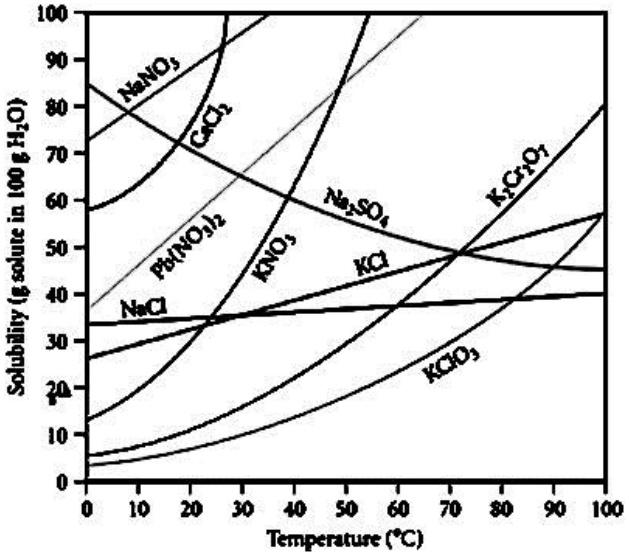
A. 19.2 *m*

B. 10.3 *m*

C. 16.6 *m*

D. 15.4 *m*

25. Use the graph to determine what occurs to a solution of $Pb(NO_3)_2$ containing 80 g of $Pb(NO_3)_2$ per 100 g of water as it cools from 60 ˚C to 20 ˚C.



A. At 60 ˚C, the solution is unsaturated. Initially, as it cools, there is no change. At some temperature between 40 ˚C and 50 ˚C, the solution becomes supersaturated and $Pb(NO_3)_2$ precipitates.

B. At 60 ˚C, the solution is supersaturated and $Pb(NO_3)_2$ will likely precipitate out. However, $Pb(NO_3)_2$ is a salt whose solubility increases as the temperature decreases. At some temperature between 40 ˚C and 50 ˚C, the precipitated $Pb(NO_3)_2$ will redissolve.

C. At 60 ˚C, the solution is unsaturated. It will remain unsaturated over the entire temperature range down to 20 ˚C. Therefore, no change in the solution will be evident.

D. At 60 ˚C, the solution is supersaturated and will likely precipitate out the excess $Pb(NO_3)_2$. As the temperature decreases, the solubility decreases and even more precipitate will form.

Answer Key:

1. D
2. B
3. A
4. D
5. B
6. A
7. D
8. C
9. D
10. A
11. B
12. C
13. A
14. C
15. B
16. C
17. D
18. A
19. B
20. A
21. C
22. D
23. B
24. C
25. A