

**Q1.** Which of the following forces are responsible for holding  $\text{NF}_3$  in the liquid state? Circle all that apply.

Ion-ion

Ion-dipole

Dipole-dipole

H-bonding

Dipole-Induced dipole

Induced dipole-Induced dipole

**Q2.** The solute-solvent interactions when  $\text{N}_2$  dissolves in water are primarily of the type:  
Circle the best correct answer.

dipole-dipole

ion-dipole

ion-ion

dipole-induced dipole

None of the Above

**Q3.** Which of the following is expected to have the highest boiling point?

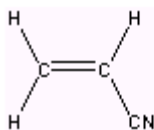
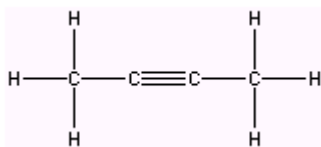
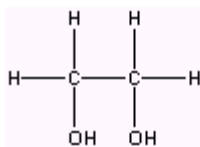
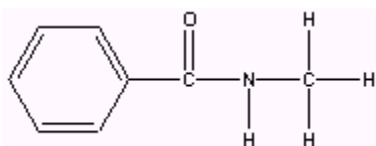
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

$\text{CH}_4$

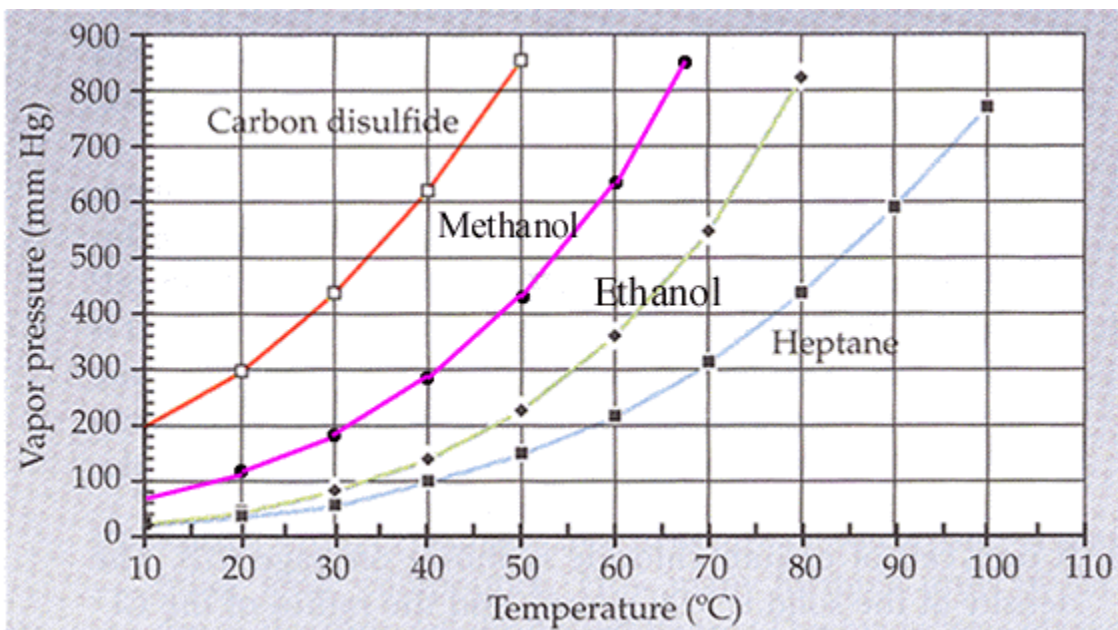
$\text{CH}_3\text{OH}$

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

**Q4.** For which of the following compounds would hydrogen bonding be expected to play an important role in holding the molecules in the liquid state. Circle all that apply.



None of the Above



**Q5. a.** From the plot of vapor pressures vs temperature above, estimate the boiling point of methanol when the external pressure is 182 mm Hg.

\_\_\_\_\_

**b.** From the plot of vapor pressures vs temperature above, estimate the normal boiling point of carbon disulfide.

\_\_\_\_\_

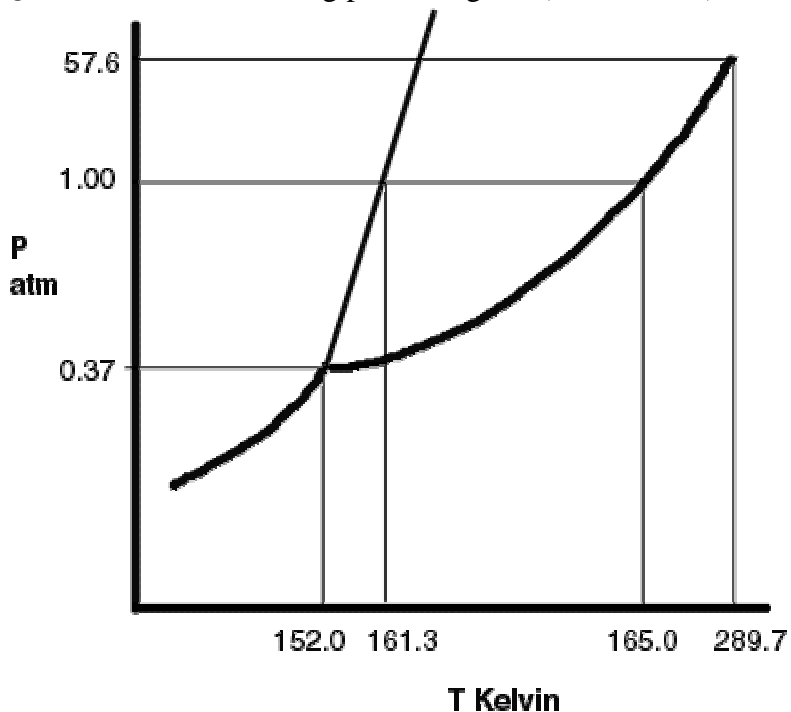
**c.** From the plot of vapor pressures vs temperature above, estimate the boiling point of carbon disulfide when the external pressure is 615 mm Hg.

\_\_\_\_\_

**d.** Which of the compounds depicted has the strongest intermolecular forces? \_\_\_\_\_

**e.** Draw a new curve on the graph for a compound with weaker intermolecular forces than any of the compounds depicted.

**Q6.** Refer to the following phase diagram (not to scale!) for xenon:



**a.** A sample of xenon at a pressure of 0.370 atm and a temperature of 137 K is compressed at constant temperature to a pressure of 63.5 atm. Which of the following are true? Circle all that apply.

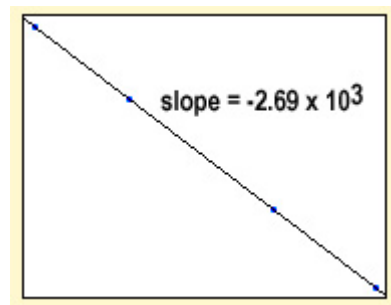
- No phase change will occur.
- The final state of the substance is a solid.
- The sample is initially a gas.
- The liquid initially present will vaporize.
- The sample is initially a solid.

**b.** Add an arrow to the diagram that shows a vaporization occurring without an increase in temperature.

**Q7.**

A plot to determine the enthalpy of vaporization of  $C_4H_{10}$  is depicted on the right.

1. Label the X axis
2. Label the Y axis
3. What is the enthalpy of vaporization in  $\text{kJ}\cdot\text{mol}^{-1}$ .

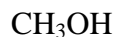


\_\_\_\_\_

**Q8.** Consider the depiction of a surfactant molecule. The long part is a hydrophobic hydrocarbon chain and the “head group” is polar. Sketch how these would form a micelle when dissolved in  $\text{CCl}_4$  instead of water. You can use a cruder version of each surfactant molecule.



**Q9.** Which of the following would be expected to dissolve extensively in water? Circle all that apply.



**Q10.** Consider the image of a lipid bilayer below. Would a nonpolar fatty molecule reside in the area labeled A or the one labeled B?



**Q11.** When two strands of DNA come together to form a double helix in water:

a. What happens to the total number of H-bonds in the total system:      increase      decrease      remain same

b. What is the primary driving force leading to formation of the double helix:

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**Q12.**

Match the following aqueous solutions with the appropriate letter from the column on the right.

- |  |                                      |
|--|--------------------------------------|
| <input type="checkbox"/> 1. 0.28 m $\text{KCH}_3\text{COO}$        | ---- A. Lowest freezing point        |
| <input type="checkbox"/> 2. 0.20 m $(\text{NH}_4)_2\text{SO}_4$    | ---- B. Second lowest freezing point |
| <input type="checkbox"/> 3. 0.18 m $\text{MgBr}_2$                 | ---- C. Third lowest freezing point  |
| <input type="checkbox"/> 4. 0.50 m <b>Glucose</b> (nonelectrolyte) | ---- D. Highest freezing point       |

**Q13.** Compare pure water and a 1.0 m aqueous solution of NaCl.

- Which has:
- a. higher vapor pressure                      water    or    the solution
  - b. higher boiling point                      water    or    the solution
  - c. higher melting point                      water    or    the solution

**Q14.** For the gas phase decomposition of hydrogen iodide at 700K  
 $2 \text{HI} = \text{H}_2 + \text{I}_2$   
the following data have been obtained:

[HI], M	1.82	0.714	0.444	0.322
t, s	0	710	1420	2130

1. The average rate of disappearance of HI over the time period from t=710 s to t=1420 s is:

\_\_\_\_\_ M.s<sup>-1</sup>

2. The average rate of appearance of I<sub>2</sub> over the same time period is:

\_\_\_\_\_ M.s<sup>-1</sup>

**Q15** The reaction of nitrogen dioxide with carbon monoxide  
 $\text{NO}_2 + \text{CO} = \text{NO} + \text{CO}_2$   
is second order in NO<sub>2</sub> and zero order in CO.

1. Write the rate law for this reaction:

\_\_\_\_\_

2. Doubling the initial concentration of CO would: (check 1)

Increase the Rate of the reaction.

\_\_\_\_\_

Decrease the Rate of the reaction.

\_\_\_\_\_

Have no effect on the Rate of the reaction.

\_\_\_\_\_

**Q16** The reaction of mercury(II) chloride with oxalate ion is found to have the following rate law:

$$\text{Rate} = k[\text{HgCl}_2][\text{C}_2\text{O}_4^{2-}]^2$$

In one experiment to determine this rate law, the rate of the reaction was found to be  $1.95 \times 10^{-4} \text{ M}\cdot\text{s}^{-1}$  when  $[\text{HgCl}_2] = 0.0710 \text{ M}$  and  $[\text{C}_2\text{O}_4^{2-}] = 0.491 \text{ M}$ . What is the value of the rate constant for this reaction. [Show Work]

**Q17** The following initial rate data are for the reduction of nitric oxide with hydrogen:  
 $2 \text{ NO} + 2 \text{ H}_2 \rightarrow \text{N}_2 + 2 \text{ H}_2\text{O}$

Exp	$[\text{NO}]_0, \text{ M}$	$[\text{H}_2]_0, \text{ M}$	Initial Rate, $\text{Ms}^{-1}$
1	0.440	0.365	0.0975
2	0.880	0.365	0.390
3	0.440	0.730	0.195

1. The order of the reaction with respect to NO is: \_\_\_\_\_
2. The order of the reaction with respect to  $\text{H}_2$  is: \_\_\_\_\_
3. The overall order of the reaction is: \_\_\_\_\_