1. Which of the following diatomic molecules is most likely to exhibit hydrogen bonding?
   A. H_2
   B. HI
   C. HCl
   D. HF
   E. all of these

2. _____ forces are found in molecules composed of nonmetal atoms of different types.

   A. Dispersion
   B. Ion - Ion
   C. Dipole - Dipole
   D. Both A and B
   E. Both A and C

3. Which of the following hydrocarbons would have the lowest boiling point?

   A. CH_4
   B. CH_3CH_3
   C. $CH_3CH_2CH_3$
   D. $CH_3CH_2CH_2CH_3$
   E. all of these would have about the same boiling point.

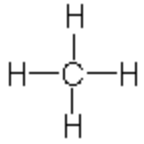
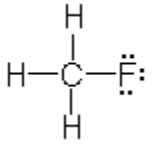
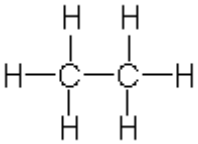
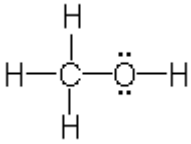
4. Which of the following would be most soluble in water?

   A. CCl_4
   B. $CH_3CH_2CH_2CH_3$
   C. CO_2
   D. CH_4
   E. NH_3

5. Substances with high boiling points are likely to also have

   A. large heats of vaporization
   B. low vapor pressures
   C. strong intermolecular forces
   D. all of these
   E. none of these

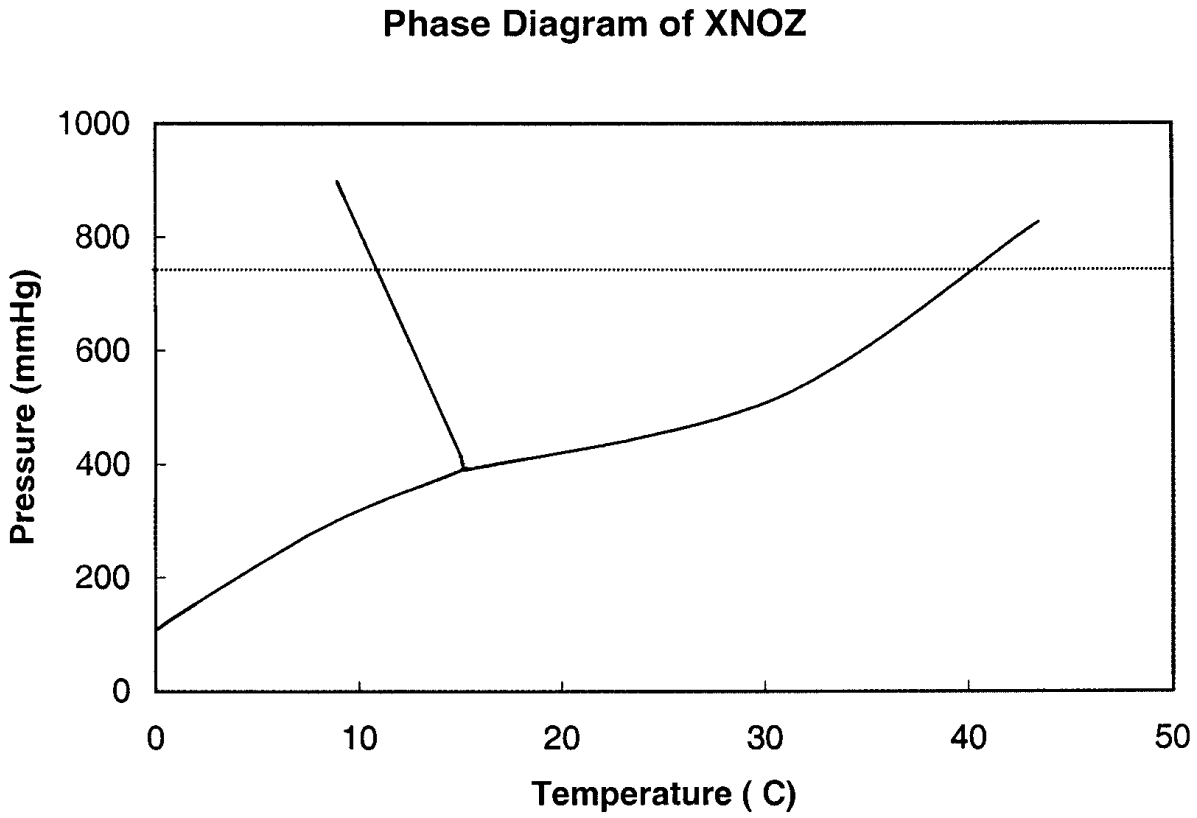
6. Which of the following would have the lowest vapor pressure at room temperature?

A.  B.  C.  D. 

7. Which of the following would most likely show significant dipole-dipole attractions ?

A. Cl_2 B. CS_2 C. CH_3CH_3 D. NCl_3 E. CO_2

Use the following Phase Diagram to answer questions 8 through 11:



8. What phase is XNOZ in at 20º C and 600 mmHg?
A. solid B. liquid C. gas D. critical phase E. metaphase

9. What is the approximate <u>normal boiling point</u> of the liquid form of XNOZ?
A. 10º C B. 15º C C. 20º C D. 30º C E. 40º C

10. What is the vapor pressure of XNOZ at 35º C?
A. 200 mmHg B. 400 mmHg C. 350 mmHg
D. 600 mmHg E. 800 mmHg

11. Moving from the point (0º C, 200 mmHg) to the point (20º C, 200 mmHg) in a straight line would be the process called:

A. condensation B. fusion C. vaporization
D. sublimation E. depositio

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12. Which of the following are exothermic processes?

A. vaporization B. condensation C. melting
D. warming E. all of these

For question 13 through 15, use the following data:

Data for Sodium (Na)
Molar Mass = 22.99 g/mol
Normal Melting Point = 98 ºC
Normal Boiling Point = 919 ºC
Heat of Fusion = 2.60 kJ/mol
Heat of Vaporization = 97.0 kJ/mol
Specific Heat Capacity for Solid = 1.23 J/g ºC

13. How much energy is required to vaporize 52.0 grams of sodium at 919 ºC?

A. 219 kJ

B. 26.8 J

C. 238 J

D. 5.88 kJ

E. 5044 kJ

14. How much energy is required for 2.00 moles of Na to go through the following process?

Na (solid, 25 ºC) → Na (liquid, 98 ºC)

A. 4.13 kJ

B. 5.20 kJ

C. 9.33 kJ

D. 2.06 kJ

E. 4.67 kJ

15. What is the best explanation for why the heat of fusion of Na is smaller than the heat of vaporization of Na?

A. Na has a lower molar mass than Pb.

B. Na has low specific heat capacity compared with other metals its size.

C. Na atoms are completely separated when they evaporate, but not when they melt.

D. Na atoms are good conductors of heat .

E. Na metal is not very dense which reduces the energy requirement for melting.

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16. The vapor pressure of pure water at 100.0 ºC is

A. 2.38 torr

B. 175 torr

C. 85 torr

D. 760 torr

E. 100 torr

Use the following reactions for the questions 17 - 19 (Data is given at 298 K):

I.	$B_2O_3\ (s) + 3\ H_2O\ (g) \rightarrow B_2H_6\ (g) + 3O_2\ (g)$	$\Delta H_I = +2035$ kJ
II.	$CCl_4\ (l) \rightarrow CCl_4\ (g)$	$\Delta H_{II} = +33$ kJ
III.	$2H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (l)$	$\Delta H_{III} = -572$ kJ
IV.	$2\ B(s) + 3\ H_2\ (g) \rightarrow B_2H_6\ (g)$	$\Delta H_{IV} = +36$ kJ
V.	$2\ NH_3\ (g) \rightarrow N_2\ (g) + 3\ H_2\ (g)$	$\Delta H_V = +92$ kJ

17. Which of the reactions above does the most work?

A. Reaction I

B. Reaction II

C. Reaction III

D. Reaction IV

E. Reaction V

18. How much work is done in **Reaction I**?

A. 2.5 kJ

B. 5.0 kJ

C. 10.0 kJ

D. 8.3 kJ

E. no work is done.

19. Calculate ΔE for **Reaction IV** at 298 K.

A. +31 kJ

B. +41 kJ

C. +38 kJ

D. +34 kJ

E. +46 kJ

20. If a solution is formed from water and NaCl, then

A. the solution will have a lower vapor pressure than that of water.

B. the solution will have a lower boiling point than that of water.

C. the solution will have a higher freezing point than that of water.

D. all of these will be true.

E. none of these will be true.

21. Consider pure water separated from an aqueous sugar solution by a semipermeable membrane, which allows water to pass freely but not sugar. After some time has passed, the concentration of the sugar solution_____.

A. will have increased.

B. will have decreased.

C. will not have changed.

D. might have increased or decreased.

E. will be the same on both sides of the membrane.

22. Solutions that have identical osmotic pressures are called _____ solutions.

A. hypertonic

B. isotonic

C. hypotonic

D. isotropic

E. dyalitic

23 Which of the following aqueous solutions will have the highest freezing point?

A. 0.100 m NaCl

B. 0.100 m $MgSO_4$

C. 0.100 m $FeBr_3$

D. 0.100 m $C_6H_{12}O_6$

E. all of these solutions will have the same freezing point.

24. Phenol is a solvent that has the following properties:
Normal Boiling Point = 182 ºC
Boiling Point Elevation Constant (K_b) = 3.04 ºC/m.

If 0.850 moles of a solute are dissolved in 525 grams of phenol. What will be the boiling point of this solution? (Assume that the solute does not dissociate.)

A. 182 ºC

B. 185 ºC

C. 177 ºC

D. 187 ºC

E. 189 ºC

25. 1 mole of compound is dissolved in 1.00 kg of water to make a solution and the observed freezing point is lower than -1.86 ºC , this could be explained by

A. ionization of the compound.

B. a change in solution density.

C. excessive ion-pairing.

D. a change in osmotic pressure.

E. all of the above would explain this observation.

26. An aqueous solution is prepared by dissolving 2.65 grams of aspartame in enough water to make 1.00 L of solution. If this solution has an osmotic pressure of 0.224 atm at 30.0 ºC, what is the molar mass of aspartame? (Note: Apartame is the artificial sweetener known as Nutrasweet. It does not dissociate in water.)

A. 294 g/mol

B. 265 g/mol

C. 354 g/mol

D. 111 g/mol

E. 29.2 g/mol

27. At a given temperature, 4.00 moles of benzene is mixed with 3.00 moles of toluene to form a solution. The vapor pressure of pure benzene = 745 torr, and the vapor pressure of pure toluene = 290. torr. Assuming the solution behaves ideally, what is the vapor pressure of toluene above the surface of the solution?

A. 124 torr

B. 425 torr

C. 166 torr

D. 320. torr

E. 550. torr