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## 2.9-010

Which of the following has the greatest ionic character?

- (a) HF    (b) HCl    (c) HBr    (d) HI

## 2.9-020

For simple ionic compounds, the partners are strongly charged and the dipole moment depends primarily on the distance between the partners. Which of the following has the largest dipole moment?

- (a) KCl    (b) LiCl    (c) KF    (d) LiF

2.9-030

Which of the following has the largest dipole moment?

- (a)  $\text{NH}_3$  (b)  $\text{PH}_3$  (c)  $\text{AsH}_3$  (d)  $\text{SbH}_3$

2.9-035

Which of the following has the largest dipole moment?

- (a)  $\text{NF}_3$  (b)  $\text{PF}_3$  (c)  $\text{AsF}_3$

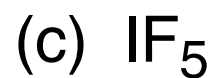
## 2.9-040

The bond angles in  $\text{H}_2\text{S}$  and  $\text{PH}_3$  are  $\sim 90^\circ$ . Other things being equal, if the bond angles in either of these molecules was closer to the  $\sim 105^\circ$  in  $\text{H}_2\text{O}$  and  $\text{NH}_3$ , the dipole moment would be

- (a) greater      (b) the same      (c) smaller

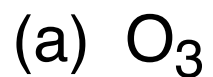
2.9-050

Which of the following is polar?



## 2.9-060

Which of the following can be heated by microwaves?



2.9-065

Which of the following cannot be heated by microwaves?



## 2.9-070

Which bond has the highest frequency stretch vibration?



## 2.9-080

Among the non-metal fluorides HF, BF<sub>3</sub>, SiF<sub>4</sub>, PF<sub>5</sub> and SF<sub>6</sub>, the number that cannot be detected by infrared (vibrational) spectroscopy is

- (a) 0      (b) 1      (c) 4      (d) 5

## 2.9-085

Which of the following cannot be a greenhouse gas?



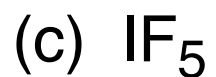
## 2.9-111

Which of the following is polar?

- (a)  $\text{CH}_4$                       (b)  $\text{CH}_2\text{Cl}_2$   
(c)  $\text{C}_2\text{H}_4$                       (d)  $\text{C}_2\text{H}_6$

## 2.9-112

Which of the following is polar?



## 2.9-118

What is the preferred orientation of one  $\text{NF}_3$  molecule relative to another?

- (a) a F of one near the N of the other
- (b) a F of one near a F of the other
- (c) the N of one near the N of the other
- (d) the N of one near the middle of the triangle formed by the 3 F's of the other

## 2.9-120

Which of the following forms hydrogen bonds?

- (a) HF    (b) HCl    (c) HBr    (d) HI

Which of the following does not form hydrogen bonds?

- (a) CH<sub>4</sub>    (b) NH<sub>3</sub>    (c) H<sub>2</sub>O    (d) HF

Which of the following forms hydrogen bonds?

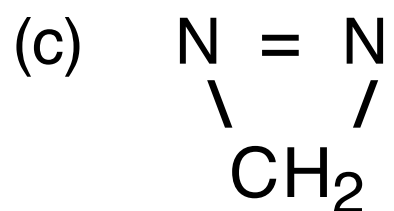
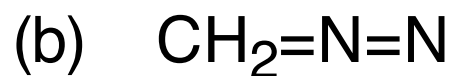
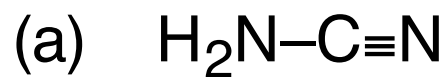
- (a) CH<sub>3</sub>-CH<sub>2</sub>-OH    (b) CH<sub>3</sub>-O-CH<sub>3</sub>  
(c) CH<sub>3</sub>-CH<sub>2</sub>-SH    (d) CH<sub>3</sub>-S-CH<sub>3</sub>

Which of the following does not form hydrogen bonds?

- (a) CH<sub>3</sub>-CH<sub>2</sub>-NH<sub>2</sub>  
(b) CH<sub>3</sub>-CH<sub>2</sub>-OH  
(c) CH<sub>3</sub>-CH<sub>2</sub>F

2.9-125

Which of the following forms of  $\text{CH}_2\text{N}_2$  forms hydrogen bonds?



## 2.9-128

What is the preferred orientation of one  $\text{NH}_3$  molecule relative to another?

- (a) a H of one near the N of the other
- (b) a H of one near a H of the other
- (c) the N of one near the N of the other
- (d) the N of one near the middle of the triangle formed by the 3 H's of the other

## 2.9-130

The variation in the boiling points of the silanes

	<b>b.p. (°C)</b>
<b>SiH<sub>4</sub></b>	-111.8
<b>SiF<sub>4</sub></b>	-86.
<b>SiCl<sub>4</sub></b>	57.57
<b>SiBr<sub>4</sub></b>	240.
<b>SiI<sub>4</sub></b>	287.5

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-140

The relative values of the following boiling points

	<b>b.p. (°C)</b>
<b>CH<sub>4</sub></b>	-164
<b>SiH<sub>4</sub></b>	-111.8
<b>C<sub>2</sub>H<sub>6</sub></b>	-88.6
<b>Si<sub>2</sub>H<sub>6</sub></b>	-14.5

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-150

The relative values of the following boiling points

	$\mu$ (debyes)	b.p. ( $^{\circ}\text{C}$ )
<b>CH<sub>3</sub>F</b>	1.85	-78.4
<b>CH<sub>3</sub>Cl</b>	1.87	-24.2
<b>CH<sub>3</sub>Br</b>	1.81	3.6

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-155

The relative values of the following boiling points

	$\mu$ (debyes)	b.p. ( $^{\circ}\text{C}$ )
chlorobenzene ( $\text{C}_6\text{H}_5\text{Cl}$ )	1.69	132
bromobenzene ( $\text{C}_6\text{H}_5\text{Br}$ )	1.70	156
iodobenzene ( $\text{C}_6\text{H}_5\text{I}$ )	1.70	188

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-160

The relative values of the following boiling points

	$\mu$ (debyes)	b.p. ( $^{\circ}\text{C}$ )
1,4-difluorobenzene	0	89
1,3-difluorobenzene	1.58	207

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-161

The relative values of the following boiling & melting points

	$\mu$ (debyes)	b.p. (°C)	m.p. (°C)
<i>p</i> (1,4)-dichloro- benzene	0	175	53
<i>m</i> (1,3)-dichloro- benzene	1.72	174	-25
<i>o</i> (1,2)-dichloro- benzene	2.50	181	-17

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-165

The relative values of the boiling points of the following forms of  $C_4H_8O$

	$\mu$ (debyes)	b.p. ( $^{\circ}C$ )
butyraldehyde ( $CH_3CH_2CH_2CH=O$ )	2.72	75
tetrahydrofuran (heterocycle)	1.63	25

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-170

The relative values of the boiling points of the following forms of  $C_2H_4O$

	$\mu$ (debyes)	b.p. ( $^{\circ}C$ )
oxirane (heterocycle)	1.89	10.7
acetaldehyde ( $CH_3-CH=O$ )	2.69	20.8

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-175

The relative values of the boiling and melting points of the following isoelectronic compounds

	$\mu$ (debyes)	b.p. (°C)	m.p. (°C)
toluene (C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> )	0.36	10.7	-95
fluorobenzene (C <sub>6</sub> H <sub>5</sub> F)	1.60	20.8	-41

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-180

The relative values of the boiling and melting points of the following isoelectronic compounds

	$\mu$ (debyes)	b.p. (°C)	m.p. (°C)
aminobenzene (C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub> )	1.53	184	-6.3
fluorobenzene (C <sub>6</sub> H <sub>5</sub> F)	1.60	20.8	-41.2

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-185

The relative values of the boiling and melting points of the following isoelectronic compounds

	$\mu$ (debyes)	b.p. (°C)
methylmercaptan (CH <sub>3</sub> SH)	1.52	6.2
methylphosphine (CH <sub>3</sub> PH <sub>2</sub> )	1.10	-14

can be explained by

- (a) dispersion forces
- (b) dipole-dipole forces
- (c) hydrogen bonding
- (d) none of the above

## 2.9-190

Which of the following would you expect to have the highest boiling point?

- (a)  $\text{CH}_3\text{-OH}$
- (b)  $\text{CH}_3\text{-O-CH}_3$
- (c)  $\text{CH}_4$
- (d)  $\text{CH}_3\text{-CH}_2\text{-OH}$

The lowest?

## 2.9-210

Which of the following is negative?

(a)  $\Delta H_{\text{vaporization}}$

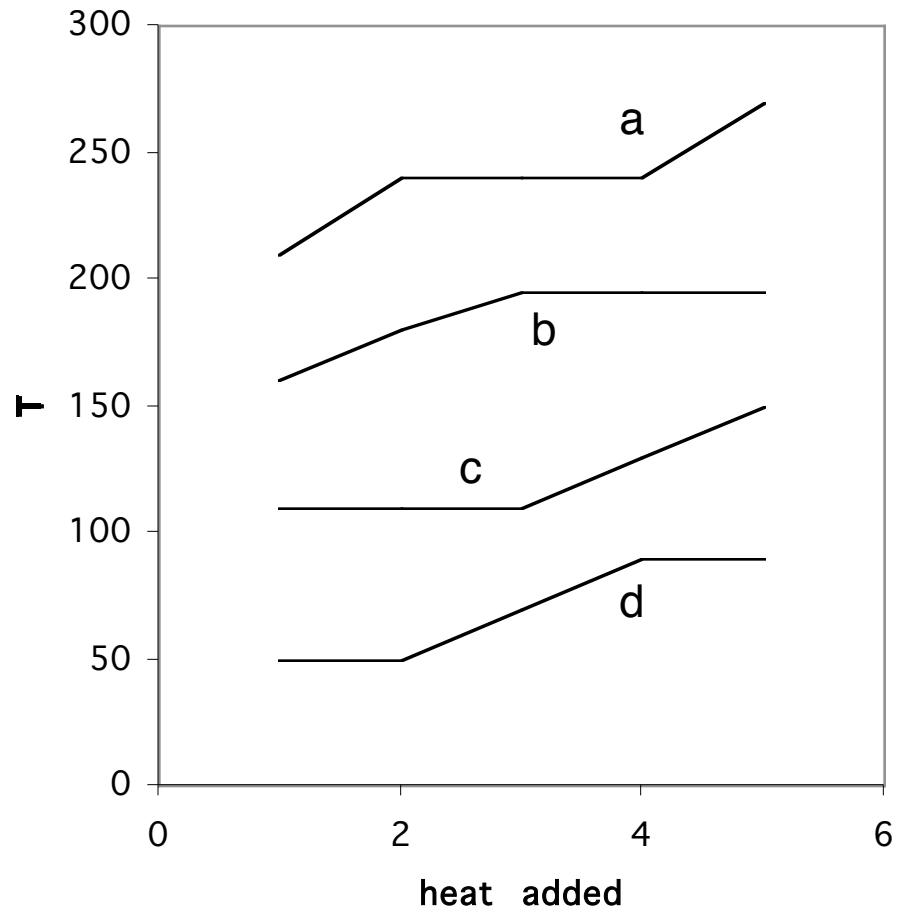
(b)  $\Delta H_{\text{fusion}}$

(c)  $\Delta H_{\text{freezing}}$

(d)  $\Delta H_{\text{sublimation}}$

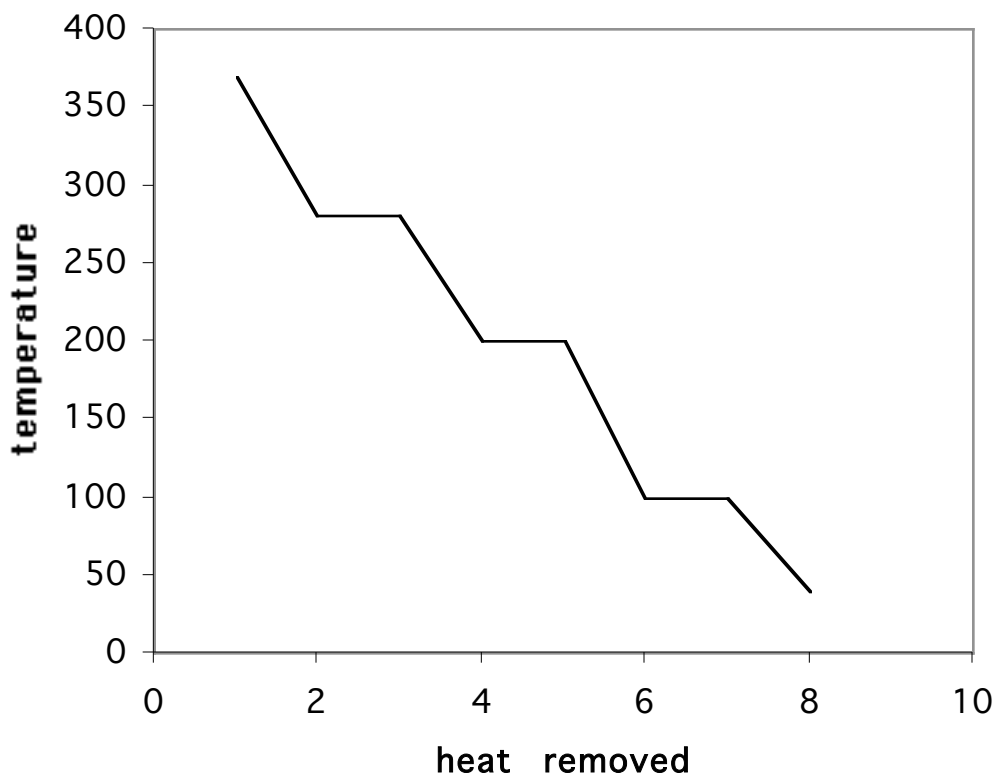
## 2.9-220

Which of the following heating curves shows two phase transitions?



## 2.9-225

The following describes the cooling of a gas at 1 atm.

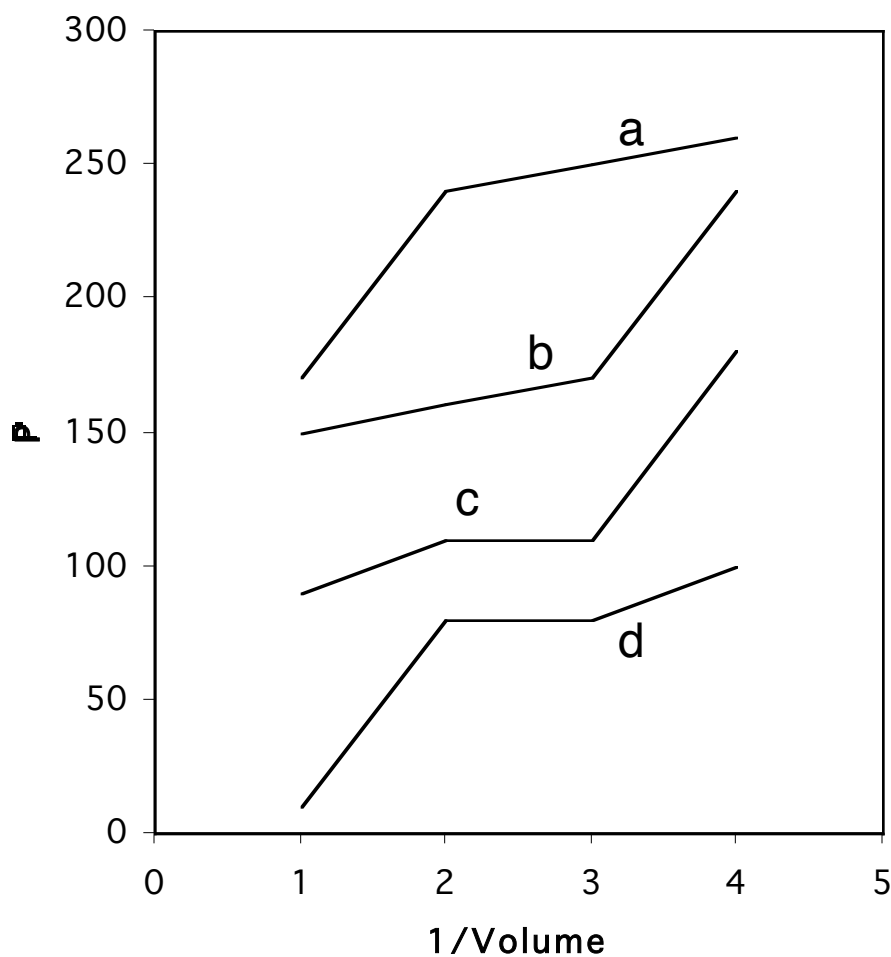


The number of condensed phases exhibited in this experiment is

- (a) 1      (b) 2      (c) 3      (d) 4

## 2.9-227

Which of the following describes the compression of a gas to give a condensed phase?



## 2.9-231

During a phase transition, which does not change?

- (a) volume
- (b) entropy
- (c) temperature

## 2.9-232

During a phase transition, which changes?

- (a) pressure
- (b) potential energy
- (c) temperature

## 2.9-241

The lowest energy state of a substance is a

- (a) solid
- (b) liquid
- (c) gas
- (d) varies from substance to substance

## 2.9-242

The highest entropy state of a substance is  
a

- (a) solid
- (b) liquid
- (c) gas
- (d) varies from substance to substance

## 2.9-243

The densest state of a substance is a

- (a) solid
- (b) liquid
- (c) gas
- (d) varies from substance to substance

## 2.9-250

Equilibrium represents a balance between

- (a) minimizing  $E$ ,  
minimizing  $V$ , &  
maximizing  $S$
- (b) minimizing  $E$ ,  
maximizing  $V$ , &  
maximizing  $S$
- (c) minimizing  $E$ ,  
maximizing  $V$ , &  
minimizing  $S$
- (d) maximizing  $E$ ,  
minimizing  $V$ , &  
maximizing  $S$

## 2.9-251

High temperature favors the state with the

- (a) lowest E
- (b) lowest V
- (c) lowest S
- (d) highest S

## 2.9-252

High pressure favors the state with the

- (a) lowest E
- (b) highest S
- (c) lowest V
- (d) highest V

## 2.9-253

Low pressure and low temperature favors the state with the

- (a) lowest E
- (b) highest S
- (c) lowest V
- (d) highest V

## 2.9-261

At very low pressures, equilibrium represents a balance between

- (a) minimizing E & maximizing S
- (b) minimizing E & maximizing V
- (c) minimizing E & minimizing V
- (d) minimizing E & minimizing S

With increasing temperature, the balance will

- (a) shift toward minimizing E
- (c) shift toward minimizing V
- (c) shift toward maximizing S
- (d) stay the same

## 2.9-262

At very low temperatures, equilibrium represents a balance between

- (a) minimizing E & maximizing S
- (b) minimizing E & maximizing V
- (c) minimizing E & minimizing V
- (d) minimizing E & minimizing S

With increasing pressure, the balance will

- (a) shift toward minimizing E
- (c) shift toward minimizing V
- (c) shift toward maximizing S
- (d) stay the same

## 2.9-270

Condensed states are low energy, low volume, low entropy states. They are most favored by

- (a) low  $P$  and low  $T$
- (b) low  $P$  and high  $T$
- (c) high  $P$  and low  $T$
- (d) high  $P$  and high  $T$

## 2.9-280

Dry ice is frozen carbon dioxide. At atmospheric pressure, dry ice sublimates directly into the gas phase without melting. What do you need to do to get liquid carbon dioxide from dry ice?

- (a) decrease the temperature and increase the pressure
- (b) increase the temperature and decrease the pressure
- (c) decrease both the temperature and the pressure
- (d) increase both the temperature and the pressure

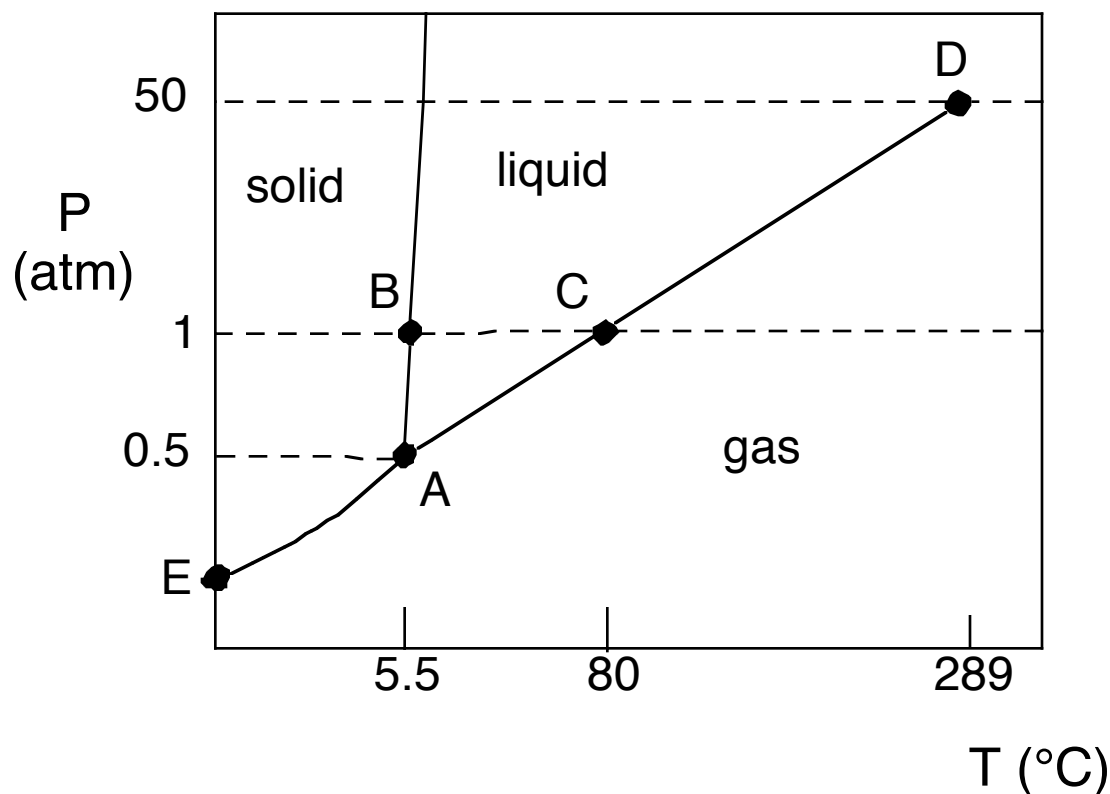
## 2.9-285

If a liquid is less dense than the solid that it freezes into, would you expect that increasing the pressure would

- (a) decrease the melting temperature
- (b) increase the melting temperature
- (c) not affect the melting temperature
- (d) depends on the boiling point

## 2.9-290

Consider the phase diagram for benzene.



Which is the normal boiling point?

Which is the normal freezing point?

Which is the critical point?

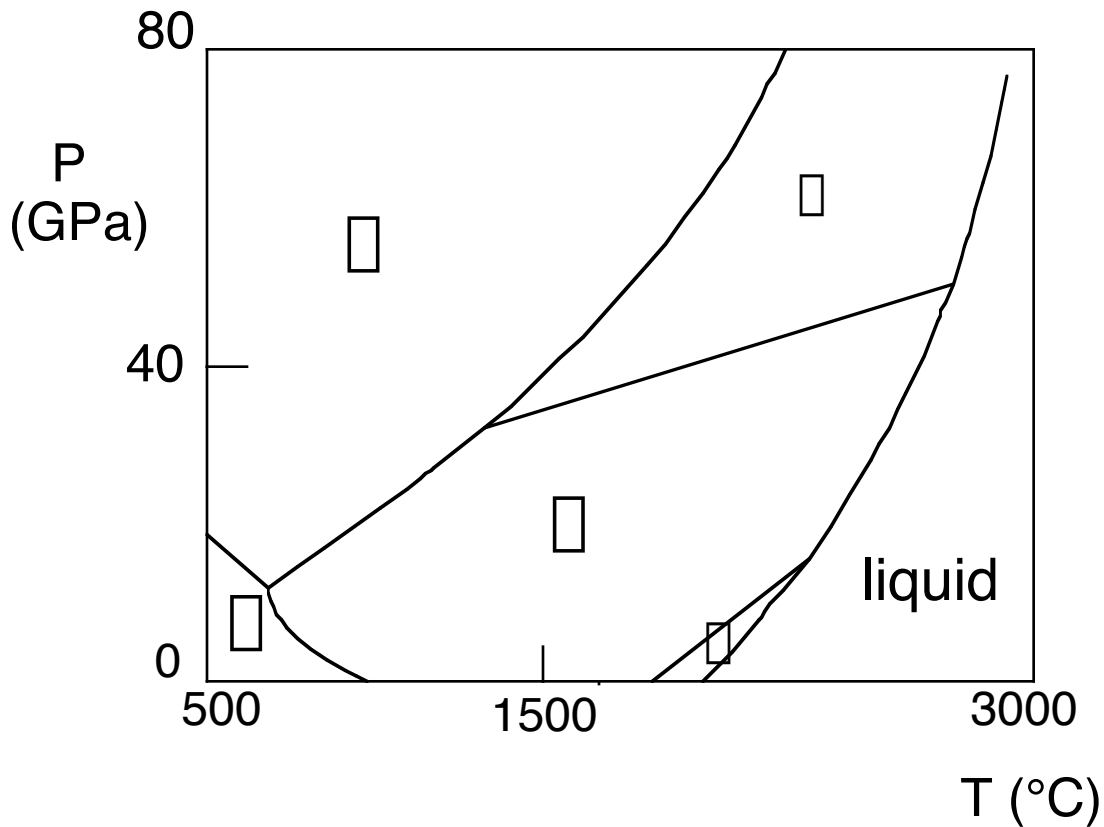
Which is the triple point?

Sublimation occurs at pressures

(a)  $> 50$  atm    (b)  $= 1$  atm    (c)  $< 0.5$  atm

## 2.9-293

Consider the following phase diagram for pure iron at geologically relevant pressures and temperatures.



At 1500°C, the densities of the phases have the relationship

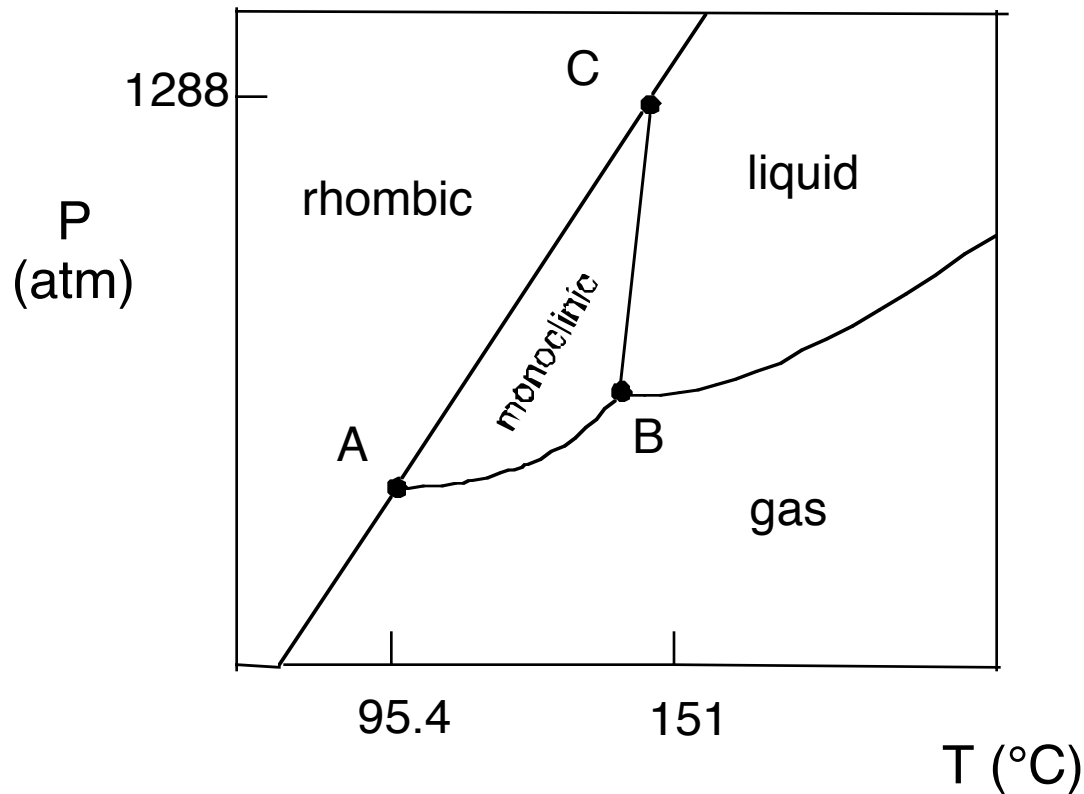
- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| (a) $\square > \square > \square$ | (b) $\square > \square > \square$ |
| (c) $\square > \square > \square$ | (b) $\square > \square > \square$ |

At 40 Gpa, heating from 500°C to 3000°C results in

- |       |       |       |       |
|-------|-------|-------|-------|
| (a) 1 | (b) 2 | (c) 3 | (d) 4 |
|-------|-------|-------|-------|
- phase transitions

## 2.9-295

Consider the following phase diagram for pure sulfur, showing two crystalline phases that differ in the geometrical arrangements of the atoms.



At which point do the rhombic, monoclinic and liquid phases coexist?

The denser crystalline phase is the  
(a) rhombic                      (b) monoclinic

## 2.9-297

At the triple point of water,

- (a)  $T < 0^{\circ}\text{C}$
- (b)  $0^{\circ}\text{C} < T < 100^{\circ}\text{C}$
- (c)  $T > 100^{\circ}\text{C}$

At the triple point of water,

- (a)  $P < 1 \text{ atm}$
- (b)  $P = 1 \text{ atm}$
- (c)  $P > 1 \text{ atm}$

## 2.9-310

The equilibrium vapor pressure of a given liquid will decrease if

- (a) the liquid is moved to a container in which its surface area is much smaller
- (b) the volume of liquid in the container is decreased
- (c) the volume of the vapor phase is increased
- (d) the temperature is decreased

## 2.9-320

The intermolecular attractions in liquid A are considerably larger than in liquid B. Which is not expected to be larger for A than for B?

- (a) the vapor pressure at 20°C
- (b) the critical temperature
- (c) the heat of vaporization
- (d) the temperature at which the vapor pressure is 0.5 atm

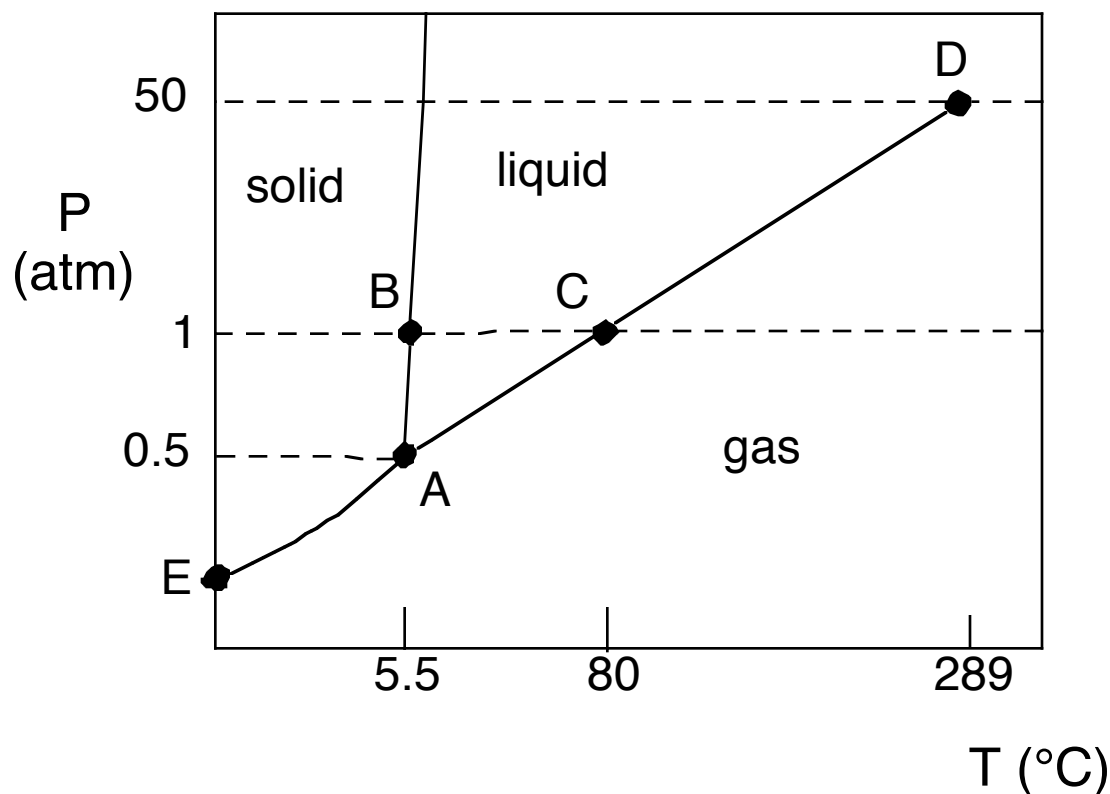
## 2.9-330

The normal boiling point of a liquid

- (a) is the temperature at which liquid and vapor are in equilibrium
- (b) varies with atmospheric pressure
- (c) is the temperature at which the vapor pressure is 1 atm
- (d) is the temperature at which the vapor pressure equals the external pressure

## 2.9-340

In the phase diagram for benzene



the vapor pressure of the liquid is given by

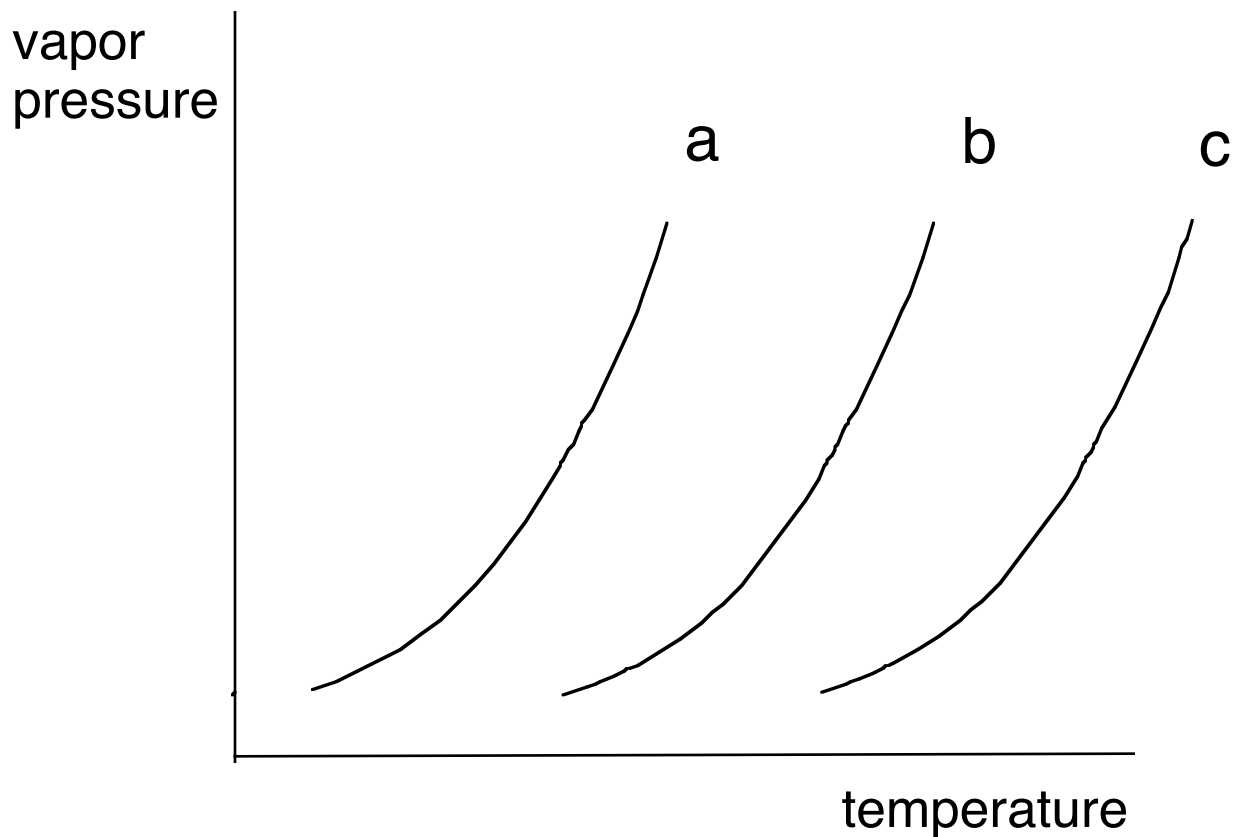
- (a) the curve AD      (b) the curve AE  
(c) the curve AB      (d) none of the above

the vapor pressure of the solid is given by

- (a) the curve AD      (b) the curve AE  
(c) the curve AB      (d) none of the above

## 2.9-350

The following diagram shows vapor pressure curves for  $\text{H}_3\text{CF}$ ,  $\text{H}_3\text{COH}$  and  $\text{H}_3\text{C=O}$ .



Which curve is for  $\text{H}_3\text{COH}$  ?

## 2.9-360

Which solid will have the lowest vapor pressure at a given temperature?

- (a) sodium chloride (ionic)
- (b) sugar (hydrogen bonded)
- (c) paraffin wax (dispersion forces)
- (d) all will be the same

## 2.9-401

When  $\text{CCl}_4$  and water are poured into the same dish, they will

- (a) mix
- (b) separate
- (c) either mix or separate depending on the order in which they are put in the dish

## 2.9-402

When crystallites of  $I_2$  are dropped in a dish containing  $CCl_4$  and water, they will

- (a) dissolve in the  $CCl_4$
- (b) dissolve in the water
- (c) dissolve in neither
- (d) dissolve in both

## 2.9-410

Which of the following is expected to be the most soluble in benzene ( $C_6H_6$ )?

- (a)  $HC_3-(CH_2)_3-F$
- (b)  $HC_3-(CH_2)_3-OH$
- (c)  $HC_3-(CH_2)_3-CH_3$
- (d)  $NaCl$

## 2.9-415

Grape Kool-Aid<sup>®</sup> is dissolved in water and flushed through a powder that is made of non-polar material. The liquid that comes through the powder is colorless. We can conclude that the color in Grape Kool-Aid comes from

- (a) polar molecules
- (b) non-polar molecules

5% isopropyl alcohol [ $\text{H}_3\text{C}-\text{CH}(\text{OH})-\text{CH}_3$ ] is then flushed through the powder and comes through red. Finally, 25% isopropyl alcohol is flushed through the powder and comes through blue. We can conclude that

- (a) the blue dye is more polar than the red
- (b) the blue dye is less polar than the red

If we had flushed the 25% isopropyl alcohol through the powder before the 5% isopropyl alcohol, it would have come through

- (a) blue
- (b) red
- (c) purple
- (d) colorless

## 2.9-420

Ethyl alcohol and water become warmer when mixed. We therefore expect the volume to

- (a) increase
  - (b) decrease
  - (c) stay the same
- on mixing.

## 2.9-430

A solution is prepared by mixing 2 mol of benzene in 1 L of hexane. Which of the following would allow us to determine the molality of the solution?

- (a) the density of the hexane
- (b) the molar mass of benzene
- (c) the volume of the solution
- (d) the molar volume of hexane

Which would allow us to determine the molarity?

Which would allow us to calculate the mole fraction?

## 2.9-440

An aqueous solution of acetone ( $\text{H}_3\text{C-CO-CH}_3$ , MW 58) is 10% acetone by weight. The mole fraction of acetone in this solution is

- (a)  $(10/58) / (90/18)$
- (b)  $(58/10) / (18/90)$
- (c)  $(10/58) / [(10/58)+(90/18)]$
- (d)  $(58/10) / [(58/10)+(18/90)]$

## 2.9-450

Cholesterol counts are given in mg/dL.  
What is the molarity of cholesterol (MW 387) in the blood of a patient with a cholesterol count of 220?

- (a)  $(220) / (387)$
- (b)  $(22.0) / (387)$
- (c)  $(2.20) / (387)$
- (d)  $(220) / (0.387)$

## 2.9-460

How many mL of 6.0 M HCl (MW 36.5) are required to prepare 200 mL of a 1.80 M solution?

- (a)  $(0.20)(1.8) / (6.0)$
- (b)  $(200)(1.8)(36.5) / (6.0)$
- (c)  $(0.20)(6.0)(36.5) / (1.8)$
- (d)  $(200) (1.8) / (6.0)$

## 2.9-470

What is the molarity of a solution of levulose (a simple sugar, MW 180) that is 5.00% levulose by weight and has a density of 1.02 g/cm<sup>3</sup>?

- (a)  $(0.05)(1020) / (180)$
- (b)  $(5.00)(1.02) / (180)$
- (c)  $(0.05) (1020) / (0.95) (1.02) (180)$
- (d)  $(0.05) / (0.95)$

What is the molality?

## 2.9-480

Suppose that 0.2 L of 0.5 M HCl is added to 0.5 L of 0.8 M HCl, making up a total volume of 0.7 L. What is the molarity of this solution?

- (a)  $(0.5 + 0.8) / (0.7)$
- (b)  $(0.1) / (0.4)$
- (c)  $(0.1 + 0.4) / (0.7)$
- (d)  $(0.5 + 0.8) / 2$

## 2.9-510

When a solution is saturated, which is not true?

- (a) the rates at which solute molecules go in and out of solution are equal
- (b) the net rate of dissolution of solute is zero
- (c) the net rate of precipitation of solute is zero
- (d) the solute concentration depends on the amount of precipitated solute present

## 2.9-520

When a gas dissolves in a liquid, its entropy

- (a) decreases
- (b) increases
- (c) changes little

When a gas dissolves in a liquid, its volume

- (a) decreases
- (b) increases
- (c) changes little

The dissolution of a gas in a liquid is favored most by

- (a) high pressure and high temperature
- (b) high pressure and low temperature
- (c) low pressure and high temperature
- (d) low pressure and low temperature

## 2.9-530

When a solid dissolves in a liquid, its entropy

- (a) decreases
- (b) increases
- (c) changes little

When a solid dissolves in a liquid, its volume

- (a) decreases
- (b) increases
- (c) changes little

The dissolution of a solid in a liquid is favored most by

- (a) high pressure
- (b) high temperature
- (c) low pressure
- (d) low temperature

## 2.9-610

Liquid solvent is in equilibrium with its vapor.

When a non-volatile solute is added to the liquid, the rate that solvent molecules

- (a) leave the vapor increases
- (b) leave the solution increases
- (c) leave the vapor decreases
- (d) leave the solution decreases

## 2.9-621

When solvent molecules can move between pure solvent and a mixture of that solvent with a non-volatile solute (by passage through a common gas phase or through a semipermeable membrane), net solvent movement is

- (a) to the solution
- (b) from the solution
- (c) zero
- (d) depends on the relative temperatures and pressures of the two liquids

## 2.9-622

When pure solvent and a mixture of that solvent with a non-volatile solute are at the same temperature and pressure, net movement of solvent molecules between the liquids is

- (a) to the solution
- (b) from the solution
- (c) zero

## 2.9-623

An open beaker of pure solvent and a mixture of that solvent with a non-volatile solute are sealed in a container. Over time

- (a) the volume of the solution increases and the volume of the solvent decreases
- (b) the volume of the solution increases and the volume of the solvent increases
- (c) the volume of the solution decreases and the volume of the solvent increases
- (d) the volume of the solution decreases and the volume of the solvent decreases

## 2.9-624

The net movement of solvent molecules from pure solvent into a solution can be stopped (or even reversed) by

- (a) increasing the temperature of the solution
- (b) increasing the temperature of the pure solvent
- (c) increasing the temperature of both

## 2.9-625

Alternatively, the net movement of solvent molecules from pure solvent into a solution can be stopped by

- (a) increasing the pressure on the solution
- (b) increasing the pressure on the pure solvent
- (c) increasing the pressure equally on both

## 2.9-630

The osmotic pressure of a 5 wt % solution of glucose (MW 180) is four times that of a 5 wt % solution of an unknown solute. The molecular weight of the unknown solute is

- (a)  $180^4$                       (b)  $4 \times 180$   
(c)  $180 / 4$                       (d) a mystery

## 2.9-640

Which of the following is not an effect of adding a non-volatile solute to a liquid

- (a) decreased vapor pressure
- (b) increased melting point
- (c) increased osmotic pressure
- (d) increased boiling point

## 2.9-650

Which of the following solutions has the highest boiling point?

- (a) 1 wt % lactose (disaccharide)
- (b) 2 wt % trehalose (disaccharide)
- (c) 2 wt % galactose  
(monosaccharide)

## 2.9-670

When I drive into the mountains, I want antifreeze protection that goes  $10^{\circ}\text{C}$  lower than normal. How much extra ethylene glycol do I need to add to a kg of radiator fluid? (The freezing point depression constant for water is  $1.86 \text{ kg K mol}^{-1}$ .)

(a)  $(10/1.86) \text{ mol}$

(c)  $(10/1.86) \text{ g}$

(b)  $(1.86/10) \text{ mol}$

(d)  $(1.86/10) \text{ g}$

## 2.9-681

When salt is added to a mixture of ice and liquid water, there will be

- (a) net movement of water molecules from the ice to the liquid
- (b) net movement of water molecules from the liquid to the ice
- (c) no net movement of water molecules

## 2.9-682

When salt is added to a mixture of ice and water, the temperature

- (a) increases
- (b) decreases
- (c) stays the same

## 2.9-690

The freezing point of soda before the bottle is opened is

- (a) higher than after it is opened
- (b) lower than after it is opened
- (c) the same as after it is opened

## 2.9-710

A beaker containing 2 mol of pure octane ( $C_8H_{18}$ ) and a beaker containing 3 mol of pure nonane ( $C_9H_{20}$ ) are enclosed in chamber I. Another 2 mol of octane is mixed with another 3 mole of nonane in another beaker, which is then enclosed in chamber II. At equilibrium, the vapor pressure in chamber I is

- (a) greater than
- (b) less than
- (c) equal to

the vapor pressure in chamber II.

## 2.9-720

Octane ( $C_8H_{18}$ ) and nonane ( $C_9H_{20}$ ) form very nearly ideal solutions. When 1 mL of octane is added to 100 mL of nonane, the boiling point of the solution falls. Which has the lowest vapor pressure?

- (a) pure octane
- (b) pure nonane
- (c) the solution

When 1 mL of nonane is added to 100 mL of octane, the boiling point of the solution

- (a) falls
- (b) rises
- (c) is unaffected

## 2.9-730

Solutions of benzene ( $C_6H_6$ ) and toluene ( $C_6H_5CH_3$ ) are ideal. At  $30^\circ C$ , the vapor pressure of pure benzene is 125 mmHg while that of pure toluene 39.0 mmHg. If a solution is prepared by mixing 1 mol benzene and 2 mol toluene at  $30^\circ C$ , the vapor at equilibrium will have

- (a) more moles of benzene than toluene
- (b) more moles of toluene than benzene
- (c) the same number of moles of toluene as of benzene

## 2.9-740

At 35°C, the vapor pressure of CS<sub>2</sub> is 512 mmHg and the vapor pressure of acetone (CH<sub>3</sub>COCH<sub>3</sub>) is 344 mmHg. A solution of CS<sub>2</sub> in acetone has a total vapor pressure of 600 mmHg. Which of the following is false?

- (a) heat must be absorbed in order to produce the solution at 35°C
- (b) a mixture of 100 mL CS<sub>2</sub> and 100 mL acetone has a volume < 200 mL
- (c) CS<sub>2</sub> and acetone are less attracted to each other than to themselves.
- (d) Raoult's Law is not obeyed by this system

## 2.9-810

To get a good diffraction pattern, it is best to use radiation with a wavelength

- (a) much longer than
- (b) about the same as
- (c) much shorter than

the lattice spacing

## 2.9-815

For a given wavelength of radiation, the spacing between diffraction spots is

- (a) larger
- (b) smaller

for smaller lattice spacings.

## 2.9-840

For a simple cubic lattice, the number of molecules per unit cell is

- (a) 1      (b) 2      (c) 4      (d) 8

The coordination number (i.e., number of nearest neighbors) for each molecule is

- (a) 3      (b) 6      (c) 8      (d) 12

If the molecule radius is  $r$ , the smallest possible cube edge length is

- (a)  $2r$       (b)  $(16/3)^{1/2}r$   
(c)  $4r$       (d)  $8^{1/2}r$

## 2.9-845

For a body-centered cubic lattice, the number of molecules per unit cell is

- (a) 2      (b) 3      (c) 5      (d) 9

The coordination number (i.e., number of nearest neighbors) for each molecule is

- (a) 3      (b) 6      (c) 8      (d) 12

If the molecule radius is  $r$ , the cube edge length is

- (a)  $2r$       (b)  $(16/3)^{1/2}r$   
(c)  $4r$       (d)  $8^{1/2}r$

## 2.9-850

For a face-centered cubic lattice, the number of molecules per unit cell is

- (a) 2      (b) 4      (c) 7      (d) 14

The coordination number (i.e., number of nearest neighbors) for each molecule is

- (a) 4      (b) 6      (c) 8      (d) 12

If the molecule radius is  $r$ , the cube edge length is

- (a)  $2r$       (b)  $(16/3)^{1/2}r$   
(c)  $4r$       (d)  $8^{1/2}r$