

Multiple Choice practice test States of matter

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- C 1. A sample of an ideal gas is cooled from 50.0°C to 25.0°C in a sealed container of constant volume. Which of the following values for the gas will decrease?
- I. The average molecular mass of the gas
 II. The average distance between the molecules
 III. The average speed of the molecules
- a. I only
 b. II only
 c. III only
 d. I and III
 e. II and III
- C 2. A sample of 0.0100 mole of oxygen gas is confined at 37°C and 0.216 atmosphere. What would be the pressure of this sample at 15°C and the same volume?
- a. 0.0876 atm
 b. 0.175 atm
 c. 0.201 atm
 d. 0.233 atm
 e. 0.533 atm
- C 3. (99-32) A 2.00-liter sample of nitrogen gas at 27°C and 600. millimeters of mercury is heated until it occupies a volume of 5.00 liters. If the pressure remains unchanged, the final temperature of the gas is
- a. 68°C
 b. 120°C
 c. 477°C
 d. 677°C
 e. 950°C
- C 4. $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{K}^+ + 2\text{OH}^- + \text{H}_2$
 When 0.400 mole of potassium reacts with excess water at standard temperature and pressure as shown in the equation above, the volume of hydrogen gas produced is?
- a. 1.12 liters
 b. 2.24 liters
 c. 3.36 liters
 d. 4.48 liters
 e. 6.72 liters
- C 5. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmosphere. What is the partial pressure of the nitrogen?
- a. 0.13 atm
 b. 0.27 atm
 c. .63 atm
 d. 0.90 atm
 e. 6.3 atm

no change in distance

same n 310K

288K

$$\frac{0.216}{310} = \frac{P_2}{288}$$

$$P_2 = 0.201$$

300K

$$\frac{2\text{L}}{300\text{K}} = \frac{5\text{L}}{T_2}$$

$$T_2 = 750 - 273 = 477^\circ\text{C}$$

$$0.4\text{ mol K} \left| \frac{1\text{ mol H}_2}{2\text{ mol K}} \right| = 0.2\text{ mol H}_2$$

$$0.2\text{ mol H}_2 \left| \frac{22.4\text{ L}}{1\text{ mol}} \right| = 4.48\text{ L}$$

$$7.0 + 2.5 + 0.5 = 10\text{ mol total}$$

mole fraction of N_2

$$\frac{7}{10} = 0.7$$

$$P_{\text{N}_2} = 0.7 \cdot 0.9\text{ atm}$$

$$P_{\text{N}_2} = 0.63\text{ atm}$$

b 6. Which expression gives the mole fraction of H_2SO_4 in a water solution that contains 3.0 moles of H_2SO_4 in 90 grams of water?

a. $3/5$

b. $3/8$

c. $3/90$

d. $(3 \cdot 98)/(18 \cdot 90)$

e. $(3 \cdot 98)/(90/18)$

$$90 \text{ g H}_2\text{O} \div 18 \text{ g/mol} = 5 \text{ mol H}_2\text{O}$$

$$\frac{3 \text{ mol H}_2\text{SO}_4}{(3+5)} = \frac{3}{8}$$

c 7. Which change is most likely to increase the solubility of an ionic solid in water?

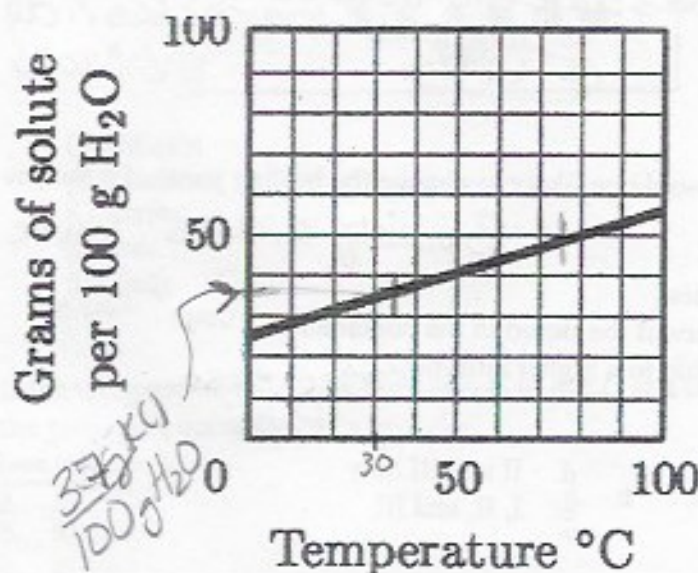
a. increasing the surface area of the solid in the system

d. increasing the external pressure of the system

b. increasing the volume of water available in the system

e. Increasing the mass of ionic solid available in the system.

c. increasing the temperature of the system



$$\frac{37 \text{ g}}{74.6 \text{ g/mol}} = 0.50 \text{ mol}$$

e 8. What is the molarity of a saturated solution of KCl (molar mass 74.6) at 35°C?

a. 0.37

b. 0.50

c. 2.0

d. 3.7

e. 5.0

$$\frac{0.50 \text{ mol}}{0.1 \text{ L}} = 5.0 \text{ M}$$

a 9. A saturated solution of KCl at 75°C contains 100g water. Which value is closest to the percent by mass of KCl in the solution? *use graph*

a. 33

b. 50

c. 60

d. 67

e. 75

$$\frac{49 \text{ g}}{49 \text{ g} + 100 \text{ g}} \times 100 = 33\%$$

e 10. When the system is cooled from 60°C to 30°C, a white crystalline solid forms. Which is the best description of the liquid phase of the system? *use graph*

a. 50g solution including 20g solute

d. 120 g solution including 20g solute

b. 60g solution including 40g solute

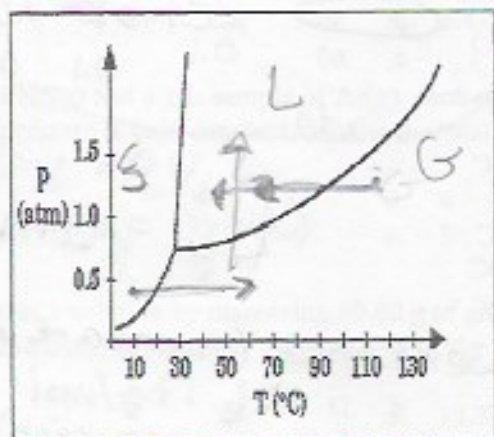
e. 135g solution including 35 g solute

c. 100 g solution including 35g solute

$$\frac{35 \text{ g solute}}{\text{total } 135 \text{ g}} \text{ in } 100 \text{ g H}_2\text{O}$$

- d 11. A mixture containing 100 g of water and 40. g of KCl is warmed to 60C and thoroughly stirred until no further changes occur.
The resulting system is best described as
- A colloid
 - a suspension
 - a saturated solution
 - d. an unsaturated solution
 - an isotonic solution
- e 12. A saturated solution of KNO_3 in equilibrium with excess solute is prepared at 20C. Which of the following describe the solution after the temperature of the system is increases to 40C while still in contact with excess solute?
- I. The molarity of the solution increases. - solubility \uparrow with $\uparrow T$
 II. The solution remains saturated. - still excess solute
 III. The density of the solution increases. - solute fits between solvent particles \therefore density increases
- II only
 - III only
 - I and III only
 - d. II and III only
 - e. I, II, III
- c 13. Which of the following actions would be likely to change the boiling point of a sample of a pure liquid in an open container?
- Boiling occurs where $P_{vap} > P_{atm}$
- ~~I.~~ Placing it in a smaller container
 - ~~II.~~ Increasing the number of moles of the liquid in the container
 - III. Moving the container and liquid to a higher altitude - decrease P_{atm}
- I only
 - II only
 - c. III only
 - II and III only
 - I, II, and III

Questions 5-7 refer to the phase diagram below of a pure substance.



- (A) Sublimation
 (B) Condensation
 (C) Solvation
 (D) Fusion
 (E) Freezing

- a 14. If the temperature increases from 10°C to 60°C at a constant pressure of 0.4 atmosphere, which of the processes occurs? $S \rightarrow G$
 (see narrative)
 a. a
 b. b
 c. c
 d. d
 e. e
- b 15. If the temperature decreases from 110°C to 40°C at a constant pressure of 1.1 atmospheres, which of the processes occurs? $G \rightarrow L$
 (see narrative)
 a. a
 b. b
 c. c
 d. d
 e. e
- b 16. If the pressure increases from 0.5 to 1.5 atmospheres at a constant temperature of 50°C , which of the processes occurs? $G \rightarrow L$
 (see narrative)
 a. a
 b. b
 c. c
 d. d
 e. e
- c 17. The weight of H_2SO_4 (molecular weight 98.1) in 50.0 milliliters of a 6.00-molar solution is
 a. 3.10 grams
 b. 12.0 grams
 c. 29.4 grams
 d. 294 grams
 e. 300. grams

$$\rightarrow 0.0500\text{L}$$

$$6.00\text{M} = \frac{X\text{mol}}{0.0500\text{L}}$$

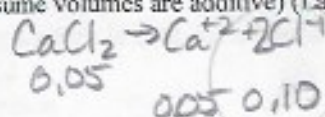
$$X = 0.3\text{mol} \left| \frac{98.1\text{g}}{1\text{mol}} \right| = 29.4\text{g}$$

$$0.2M = \frac{x}{0.25} \quad x = 0.05$$

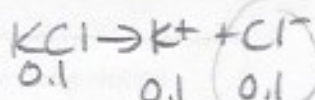
$$0.4M = \frac{x}{0.25} \quad x = 0.1$$

- d 18. What is the final concentration of Cl⁻ ion when 250mL of 0.20 M CaCl₂ solution is mixed with 250mL of 0.40 M KCl solution? (assume volumes are additive) (Last Modified 05-14-04)

- a. .10
b. .20
c. .30



- d. .40
e. .60



$$\frac{0.2 \text{ mol Cl}^-}{0.5 \text{ L}} = 0.40 \text{ M Cl}^-$$

add

- (A) H₂(g) molecules at 10⁻³ atm and 200C
(B) O₂(g) molecules at 20 atm and 200C
(C) SO₂(g) molecules at 20 atm and 200C
(D) NH₃(g) molecules at 20 atm and 200C
(E) NH₃(g) molecules at 20 atm and 300C

$$KE = \frac{1}{2} \cdot m \cdot v^2$$

- c 19. Have lowest molecular speed → lower Temps (compare A, B, C, D)

- a. A H₂ 2g/mol
b. B O₂ 32g/mol
c. C SO₂ 64g/mol

- d. D NH₃ 17g/mol
e. E (temp too high)

highest M will have lowest v

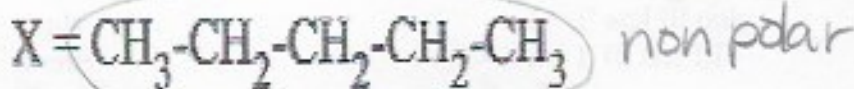
- e 20. Have highest average kinetic energy. KE is proportional to T

- a. A
b. B
c. C

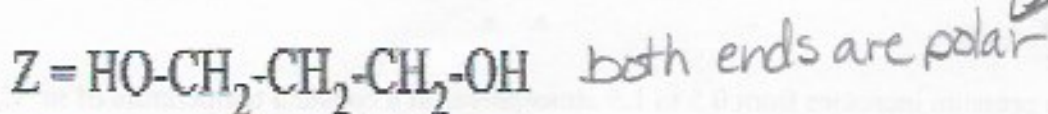
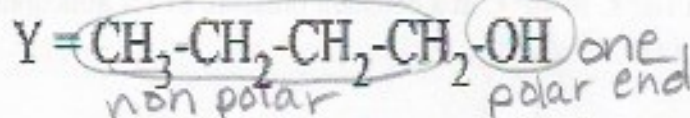
- d. D
e. E (highest T)

- e 21.

(Based on concepts of polarity and hydrogen bonding, which of the following sequences correctly lists the compounds above in the order of their increasing solubility in water?



most soluble will have highest polarity



- a. Z < Y < X
b. Y < Z < X
c. Y < X < Z

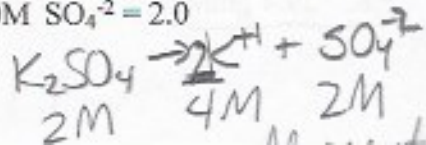
- d. X < Z < Y
e. X < Y < Z

- e 22. If 87 grams of K₂SO₄ (molar mass 174 grams) is dissolved in enough water to make 250 milliliters of solution, what are the concentrations of the potassium and the sulfate ions?

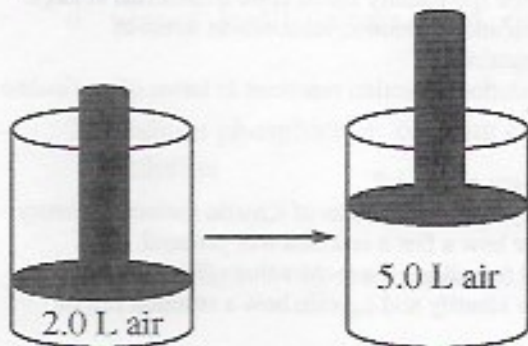
- a. K⁺ = 0.020M SO₄²⁻ = 0.020M
b. K⁺ = 1.0M SO₄²⁻ = 2.0M
c. K⁺ = 2.0M SO₄²⁻ = 1.0M

- d. K⁺ = 2.0M SO₄²⁻ = 2.0
e. K⁺ = 4.0M SO₄²⁻ = 2.0

$$87 \text{ g K}_2\text{SO}_4 / 174 \text{ g/mol} = 0.5 \text{ mol} \quad 0.5 \text{ mol} / 0.25 \text{ L} = 2 \text{ M}$$



23. What volume of water should be added to 0.4 L of 6M H_2SO_4 solution to produce a solution that is 2.0M H_2SO_4 ?
 $M_1 V_1 = M_2 V_2$
 $(0.4)(6) = (2)V_2$
 $V_2 = 1.2 L$
 total
 $0.4 + X = 1.2$
 $X = 0.8$
- a. .40
 b. .80
 c. 1.2
 d. 1.6
 e. 2.4
24. A 2 L sample of $N_2(g)$ and a 1 L sample of $Ar(g)$, each originally at 1 atm and 0C, are combined in a 1 L tank. If the temperature is held constant, what is the total pressure of the gases in the tank?
 $P_1 V_1 = P_2 V_2$
 $(1 atm)(2L) = P_2(1L)$
 $P_2 = 2 atm$
 $1 atm + 1 atm = 2 atm$
 $N_2 + Ar$
 $2L + 1L = 3L$
 $1 atm + 1 atm \rightarrow 2 atm$
- a. 1
 b. 2
 c. 3
 d. 4
 e. 5
25. A student prepares a solution by dissolving 60.00 g of glucose (molar mass 180. g/mol) in enough distilled water to make 250.0 mL of solution. The molarity of the solution should be reported as
 $\frac{60.00 g}{180 g/mol} = 0.33 mol$
 $\frac{0.33 mol}{0.25 L} = 1.32 M$
- a. 12.01M
 b. 12.0M
 c. 1.332M
 d. 13.3M
 e. .13M
26. A student prepares a solution by dissolving 60.00 g of glucose (molar mass 180. g/mol) in enough distilled water to make 250.0 mL of solution. The molarity of the solution should be reported as
 (same as above)
- a. 12.01M
 b. 12.0M
 c. 1.332M
 d. 13.3M
 e. .13M
27. When 6.0 L of $He(g)$ and 10. L of $N_2(g)$, both at 0C and 1.0 atm, are pumped into an evacuated 4.0 L rigid container, the final pressure in the container at 0C is
 $1 atm \cdot 6L + 1 atm \cdot 10L \rightarrow 4L \cdot P_2$
 $He \quad N_2 \quad P_2$
 $(16L)(1 atm) = (4L) P_2$
 $P_2 = 4.0 atm$
- a. 2.0 atm
 b. 4.0 atm
 c. 6.4 atm
 d. 8.8 atm
 e. 16 atm



c 28.

The volume of a sample of air in a cylinder with a movable piston is 2.0L at a pressure P_1 , as shown in the diagram above. The volume is increased to 5.0L as the temperature is held constant. The pressure of the air in the cylinder is now P_2 . What effect do the volume and pressure changes have on the average kinetic energy of the molecules in the sample? What effect do the volume and pressure

- a. The average kinetic energy increases.
 b. The average kinetic energy decreases.
 c. The average kinetic energy stays the same.
 d. It cannot be determined how the kinetic energy is affected without knowing P_1 and P_2

↑
 temp held constant