

Multiple Choice practice test States of matter

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 — no change
 II. The average distance between the molecules — no change
 III. The average speed of the molecules — yes!
- a. I only
 b. II only
 c. III only
 d. I and III
 e. II and III
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
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. $950.^{\circ}\text{C}$
4. 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? (Mole fraction is a ratio of mol of a substance/total mol.)
- a. $\frac{3}{5}$
 b. $\frac{3}{8}$
 c. $\frac{3}{90}$
 d. $(3 \cdot 98)/(18 \cdot 90)$
 e. $(3 \cdot 98)/(90/18)$
5. 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
 b. increasing the volume of water available in the system
 c. increasing the temperature of the system
 d. increasing the external pressure of the system
 e. Increasing the mass of ionic solid available in the system.
6. The weight of H_2SO_4 (molecular weight 98.1g/mol) 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

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

$$6.00 = \frac{x}{0.05 \text{ L}}$$

$$M = \frac{\text{mol}}{\text{L}}$$

Sol is a ratio of solute of per vol H_2O

$$\frac{V_1 P_1}{T_1} = \frac{V_2 P_2}{T_2}$$

$$\frac{2}{300} = \frac{5}{T_2}$$

$$2 \cdot T_2 = \frac{300 \cdot 5}{2}$$

$$T_2 = 750 \text{ K}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

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

cross multiply!

$$(0.216)(288) = \frac{310 \cdot P_2}{310}$$

$$P_2 = 0.201 \text{ atm}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{2}{300} = \frac{5}{T_2}$$

$$\frac{750}{-273} = \frac{477}{-273}$$

Convert to $^{\circ}\text{C}$

323K 298K

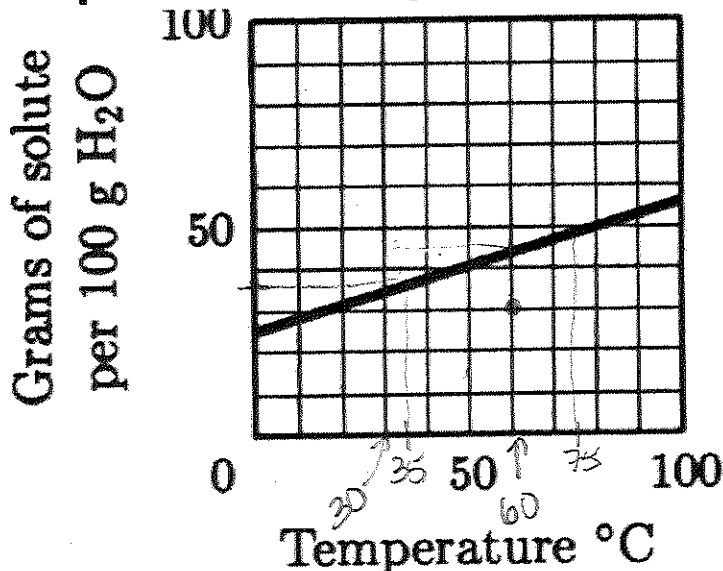
sealed container

no change

no change

yes!

Graph A: Solubility Curve of KCl



7. Use Graph A: Solubility Curve of KCl: What is the molarity of a saturated solution of KCl (molar mass 74.6g/mol) at 35°C? (1 gram water = 1 mL water)
- a. 0.37
b. 0.50
c. 2.0
d. 3.7
e. 5.0
8. Use Graph A: Solubility Curve of KCl: 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?
- a. 33
b. 50
c. 60
d. 67
e. 75
9. Use Graph A: Solubility Curve of KCl: 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?
- a. 50g solution including 20g solute
b. 60g solution including 40g solute
c. 100 g solution including 35g solute
d. 120 g solution including 20g solute
e. 135g solution including 35 g solute
10. Use Graph A: Solubility Curve of KCl: A mixture containing 100 g of water and 40.g of KCl is warmed to 60°C and thoroughly stirred until no further changes occur. The resulting system is best described as:
- a. A colloid
b. a suspension
c. a saturated solution
d. an unsaturated solution
e. an isotonic solution
11. 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.)
- a. 0.10
b. 0.20
c. 0.30
d. 0.40
e. 0.60

$M = \frac{\text{mol}}{L}$

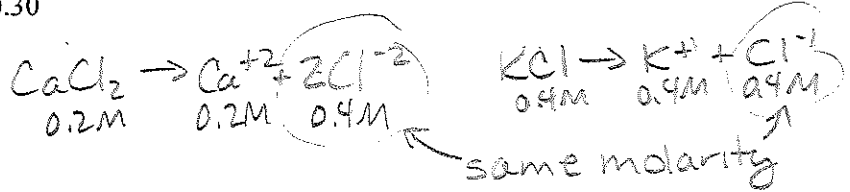
$\frac{37g}{74.6g} = 0.50 \text{ mol} \rightarrow \frac{0.50 \text{ mol}}{0.1L} = 5.0 \text{ M}$

$100g \text{ H}_2\text{O} \left| \frac{1 \text{ mL}}{1g} \right| \left| \frac{1L}{1000 \text{ mL}} \right| = 0.1L$

$\frac{50g \text{ KCl}}{(50+100)} \times 100 = 33\%$

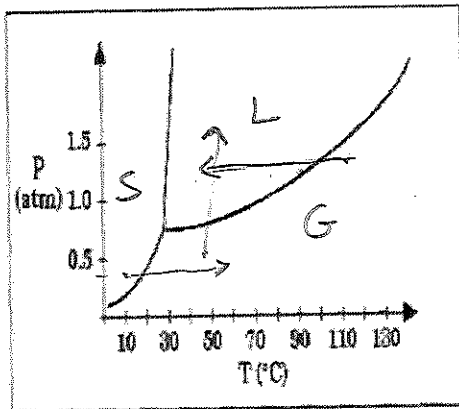
35g KCl
100g water
135g total

point 60°C + 40g KCl is under the solubility curve.



When mixing 2 substances with the same concentration M is the same.

Graph B: Triple Phase Diagram of Substance A



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

12. Use Graph B: Triple Phase Diagram of Substance A:
 If the temperature increases from 10°C to 60°C at a constant pressure of 0.4 atmospheres, which of the processes occurs?
 a. a d. d $S \rightarrow G$
 b. b e. e sublimation
 c. c
13. Use Graph B: Triple Phase Diagram of Substance A:
 If the temperature decreases from 110°C to 40°C at a constant pressure of 1.1 atmospheres, which of the processes occurs?
 (see narrative) d. d $G \rightarrow L$
 a. a e. e condensation
 b. b
 c. c
14. Use Graph B: Triple Phase Diagram of Substance A:
 If the pressure increases from 0.5 to 1.5 atmospheres at a constant temperature of 50° C, which of the processes occurs?
 a. a d. d $G \rightarrow L$
 b. b e. e condensation
 c. c
15. What volume of water should be added to 0.4 L of 6M H₂SO₄ solution to produce a solution that is 2.0M H₂SO₄?
 a. 0.40 V_1 M_1
 b. 0.80 d. 1.6
 c. 1.2 e. 2.4

$$M_1 V_1 = M_2 V_2$$

$$(6M) \cdot (0.4) = \frac{(2.0M) V_2}{2.0}$$

$$V_2 = 1.2L$$

↑
final volume

$$1.2 - 0.4 = 0.8$$

↑
amount added

Name: _____

16. A saturated solution of KNO_3 in equilibrium with excess solute is prepared at $20^\circ C$. Which of the following describe the solution after the temperature of the system is increases to $40^\circ C$ while still in contact with excess solute?

- I. The molarity of the solution increases. *yes, more will dissolve with ↑ T*
 - II. The solution remains saturated. *still at bottom so still saturated*
 - III. The density of the solution increases. *yes - dissolving increases mass without increasing volume*
- a. II only
 b. III only
 c. I and III only
 d. II and III only
 e. I, II, III

17. Which of the following actions would be likely to change the boiling point of a sample of a pure liquid in an open container?

- I. Placing it in a smaller container. *no*
- II. Increasing the number of moles of the liquid in the container. *no*
- III. Moving the container and liquid to a higher altitude. *yes atmospheric pressure is less than vapor pressure of the sample*

- a. I only
 b. II only
 c. III only
 d. II and III only
 e. I, II, and III

18. If 87 grams of K_2SO_4 (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. $K^+ = 0.020M$ $SO_4^{2-} = 0.020M$
 b. $K^+ = 1.0M$ $SO_4^{2-} = 2.0M$
 c. $K^+ = 2.0M$ $SO_4^{2-} = 1.0M$
 d. $K^+ = 2.0M$ $SO_4^{2-} = 2.0$
 e. $K^+ = 4.0M$ $SO_4^{2-} = 2.0$

19. 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

- a. 12.01M
 b. 12.0M
 c. 1.332M
 d. 13.3M
 e. .13M

Handwritten calculations:
 $250 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.250 \text{ L}$
 $M = \frac{\text{mol}}{L} = \frac{0.33 \text{ mol}}{0.250} = 1.3 \text{ M}$
 $\frac{60.00 \text{ g}}{180. \text{ g/mol}} = 0.33 \text{ mol}$

Choose from the following containers for questions #20 and #21.

- (A) $H_2(g)$ molecules at $1 \text{ E-}3 \text{ atm}$ and $200^\circ C$ — H_2 2g/mol
- (B) $O_2(g)$ molecules at 20 atm and $200^\circ C$ — O_2 32g/mol
- (C) $SO_2(g)$ molecules at 20 atm and $200^\circ C$ — SO_2 64.1g/mol
- (D) $NH_3(g)$ molecules at 20 atm and $200^\circ C$ — NH_3 17g/mol
- (E) $NH_3(g)$ molecules at 20 atm and $300^\circ C$

20. The container with the lowest molecular speed:

- a. A
 b. B
 c. C
 d. D
 e. E

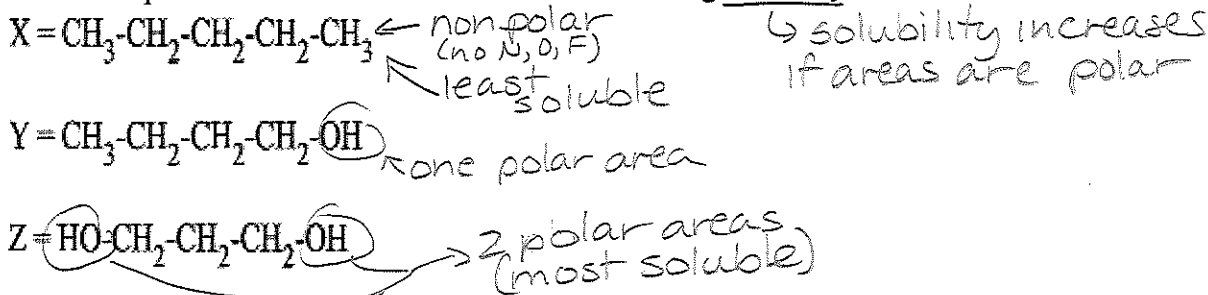
Handwritten notes:
 lowest temperature
 highest mass
 $KE = \frac{1}{2} m \cdot v^2$
 lowest velocity

21. The container with the highest average kinetic energy:

- a. A
 b. B
 c. C
 d. D
 e. E

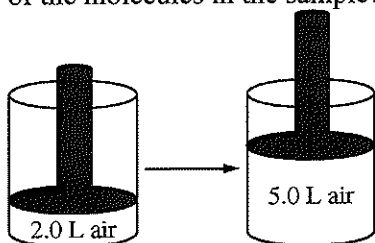
Handwritten note:
 highest temp

22. (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?)



- a. $Z < Y < X$
 b. $Y < Z < X$
 c. $Y < X < Z$
 d. $X < Z < Y$
 e. $X < Y < Z$

23. 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 below. 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?

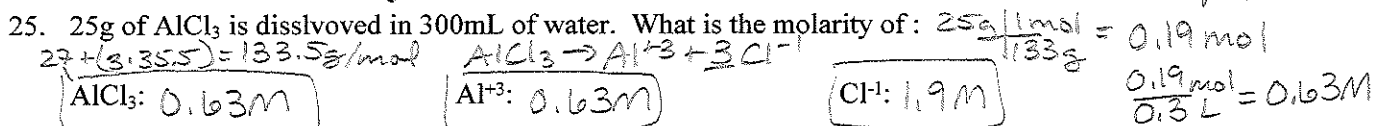


Temp ~ KE

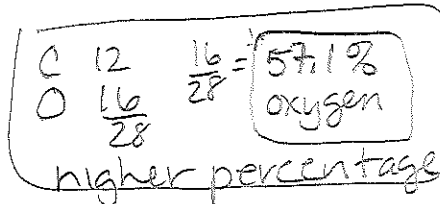
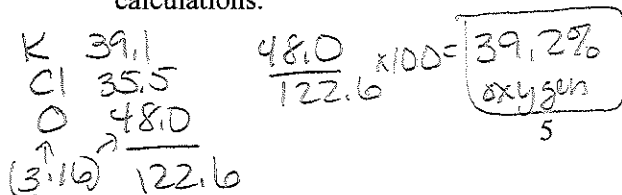
- a. The average kinetic energy increases.
 b. The average kinetic energy decreases.
 c. The average kinetic energy stays the same.
 d. It cannot be determined how the kinetic energy is affected without knowing P_1 and P_2

States of Matter - Written

24. A liquid is poured into a rigid container and sealed. The pressure is recored for a period of time, showing the pressure increased slightly and then held steady. Using the kinetic molecular theory, explain why the pressure increased and then held steady. *molecules are evaporating and increase pressure by hitting the sides of the container. It held steady when the pressure above the liquid = vapor pressure.*



26. Consider the following 2 substances: potassium chlorate (KClO_3) and carbon monoxide (CO).
- a. As a solid, which one is a bulk crystal? KClO_3 Which one is a molecule? CO
 b. What breaks when KClO_3 melts? ionic bonds What breaks when CO melts? dipole-dipole (IMF)
 c. Determine which substance (KClO_3 or CO), has a higher percentage of oxygen. Show your calculations.



Name: _____

Secondary Topic- Math Relationships

26.

1. Determine the total number of significant digits:

a. 4.3090 E15 H atoms	5	d. 4.000 Liters	4
b. 0.0003404 meters	4	e. 100 cm = 1 meter	∞
c. 2,030,000 cm	3	f. 4.40 E4 miles	3

2. Fill out the table by rounding each original number to the indicated amount of significant figures.

	original number	Round to 1 sig figs	Round to 3 sig figs	Round to 5 sig figs
a.	7.940090 E55	8 E55	7.94 E55	7.9401 E55
b.	9.0052800	9	9.01	9.0053
c.	0.0409206800	0.04	0.0409	0.040921

3. Determine the molar mass of propanol (
- C_3H_8OH
-). Use masses from the periodic table to the nearest tenth place. Maintain the correct significant figures.

$$\begin{array}{l} 3 \times 12.0 = 36.0 \\ 9 \times 1.0 = 9.0 \\ 1 \times 16.0 = 16.0 \end{array} \left. \vphantom{\begin{array}{l} 3 \times 12.0 \\ 9 \times 1.0 \\ 1 \times 16.0 \end{array}} \right\} 61.0 \text{ g/mol}$$

4. Complete the following. Show your work (factor label). Maintain the correct significant figures.

- a. Convert 4,554.0 mL to Liters.

$$4554.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 4.5540 \text{ L}$$

- b. Convert 9.01 moles propanol (
- C_3H_8OH
-) to mass in grams.

$$9.01 \text{ mol} \times \frac{61.0 \text{ g}}{1 \text{ mol}} = 549.61 \rightarrow 550 \text{ g} \quad (5.50 \text{ E}2 \text{ grams})$$

- c. Convert 750 grams propanol (
- C_3H_8OH
-) to moles.

$$750 \text{ g} \times \frac{1 \text{ mol}}{61.0 \text{ g}} = 12.3 \rightarrow 12 \text{ mol}$$

- d. How many molecules are in 5.55 grams propanol (
- C_3H_8OH
-)? (Hint: Remember to convert to moles first.)

$$5.55 \text{ g} \times \frac{1 \text{ mol}}{61.0 \text{ g}} \times 6.022 \text{ E}23 = 5.48 \text{ E}22 \text{ molecules}$$

5. Determine the correct answer. Round to the correct number of significant figures.

$$447.1 \times 80 = 35,768 \rightarrow 40,000$$

$$6.4400 / 0.0034 = 1894 \rightarrow 1900$$

$$4,060 + 89.2099 =$$

$$\begin{array}{r} 4,060 \\ + 89.2099 \\ \hline 4,149.2099 \\ \downarrow \\ 4,150 \end{array}$$

$$345.678 - 4.4 =$$

$$\begin{array}{r} 345.678 \\ - 4.4 \\ \hline 341.278 \\ \downarrow \\ 341.3 \end{array}$$