Key

States of Matter Test Review

Solve each problem AND name the gas law that you used.

1. A gas is held at a constant pressure while its volume decreases from 450 mL to 200 mL. What will the final temperature be if the initial temperature is 25.0°C? (Express the temperature in K.)

   a) What law is this? Charles
   b) What is the relationship? direct
   c) Predict whether the variable asked for will increase or decrease decrease
   d) Solve the problem

	1	2
P		
V	450 mL	200 mL
T	298.0K	X

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{(450\,mL)}{298.0K} = \frac{200\,mL}{X}$

X = 100 K

2. The pressure on a gas is increased from 572 mm Hg to 1425 mm Hg. What will the new volume of the gas be if the original volume was 4.5 L?

   a) What law is this? Boyles
   b) What is the relationship? inverse
   c) Predict whether the variable asked for will increase or decrease decrease
   d) Solve the problem

	1	2
P	572 mmHg	1425 mmHg
V	4.5 L	X
T		

$P_1V_1 = P_2V_2$

$(572\,mmHg)(4.5L) = (1425\,mmHg)\,x$

x = 1.8 L

3. An 8.0 L sample of helium gas at standard pressure is allowed to expand to a new volume of 22.0 L. If the temperature of the gas does not change, what is the new pressure of the gas expressed in atm?

   a) What law is this? Boyles
   b) What is the relationship? inverse
   c) Predict whether the variable asked for will increase or decrease decrease
   d) Solve the problem

	1	2
P	1.00 atm	X
V	8.0 L	22.0 L
T		

$P_1V_1 = P_2V_2$

$(1.00\,atm)(8.0L) = x\,(22.0L)$

x = 0.36 atm

A sample of a gas has a volume of 32 L and a temperature of 10°C. If the pressure is not changed, to what temperature must it be raised in order to double the volume? (Express the temperature in kelvins.)

a) What law is this? Charles
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P		
V	32 L	64 L
T	283 K	X

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{32\,L}{283\,K} = \frac{64\,L}{x}$

570 K

5. What is the density of a sulfur dioxide gas if it occupies 36.0 L at STP? → SO_2 extra info

a) What law is this? ideal w/ density
b) Solve the problem

D = x
M = 64.00 g/mol
P = 1.00 atm
R = 0.0821 $\frac{L\,atm}{mol\,K}$
T = 273 K

$D = \frac{(64.00\,g/mol)(1.00\,atm)}{(0.0821\,\frac{L\,atm}{mol\,K})(273\,K)}$

D = 2.86 g/L

6. If the pressure remains constant, what volume will 42.3 mL of a gas at 24°C occupy at standard temperature?

a) What law is this? Charles
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease decrease
d) Solve the problem

	1	2
P		
V	42.3 mL	X
T	297 K	273 K

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

$\frac{42.3\,mL}{297\,K} = \frac{X}{273\,K}$

X = 38.9 mL

7. A sample of a gas has a mass of 14.2 g and occupies a volume of 678 mL at 25.0°C and a pressure of 0.80 atm.

a) What law is this? ideal w/ density
b) Solve the problem
   i) Calculate the molar mass of the gas.

$D = \frac{m}{V} = \frac{14.2\,g}{0.678\,L} = 20.9\,\frac{g}{L}$

D = 20.9 g/L
M = x
P = 0.80 atm
R = 0.0821 $\frac{L\,atm}{mol\,K}$
T = 298.0 K

$D = \frac{MP}{RT}$

$\frac{20.9\,g/L}{1} = \frac{x\,(0.80\,atm)}{(0.0821\,\frac{L\,atm}{mol\,K})(298.0\,K)}$

x = 640 g/mol

   ii) What is the density of the gas at the original temperature and pressure?

$D = \frac{m}{V} = \frac{14.2\,g}{0.678\,L} =$ 20.9 g/mol

8. A gas at 300 K occupies 6.50L at a pressure of 355 kPa. What will its pressure be at 250 K if its volume is reduced to 4.80L?

a) What law is this? combined
b) What is the relationship? N/A
c) Predict whether the variable asked for will increase or decrease N/A
d) Solve the problem

1	2
P 355 kPa	x
V 6.50 L	4.80 L
T 300 K	250 K

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(355\text{kPa})(6.50\text{L})}{300\text{K}} = \frac{x\,(4.80\text{L})}{250\text{K}}$$

$x = 400$ kPa

9. At 120°C, a gas exerts a pressure of 3.6 atm when its volume is 0.495 L. What is the volume of this gas at STP?

a) What law is this? combined
b) What is the relationship? N/A
c) Predict whether the variable asked for will increase or decrease N/A
d) Solve the problem

1	2
P 3.6 atm	1.00 atm
V 0.495 L	x
T 393K	273K

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(3.6\text{atm})(0.495\text{L})}{393\text{K}} = \frac{(1.00\text{atm})(x)}{273\text{K}}$$

$x = 1.2$ L

10. A fluorine gas sample occupies 319 mL at 54.3°C and a pressure of 87.4 kPa. Calculate the gas's density at STP. → F_2 b/c diatomic

extra info

a) What law is this? ideal w/ density
b) Solve the problem

D = x
M = 38.00 g/mol
P = ~~87.4 kPa~~ 101.3 kPa
R = 8.314 $\frac{\text{L kPa}}{\text{mol K}}$
T = ~~327.3K~~ 273K

$$D = \frac{MP}{RT}$$

$$D = \frac{(38.00\text{ g/mol})(\cancel{87.4\text{kPa}}\ 101.3)}{(8.314\frac{\text{L kPa}}{\text{mol K}})(\cancel{327.3\text{K}}\ 273\text{K})}$$

$x = 1.70$ g/L

11. A 441-L sample of nitrogen gas at a pressure of 88.3 kPa is placed into a container of equal volume that already holds hydrogen gas at a pressure of 125.6 kPa. What is the partial pressure of the nitrogen in the new container?

a) What law is this? Boyle's
b) What is the relationship? inverse
c) Predict whether the variable asked for will increase or decrease stay the same
d) Solve the problem

1	2
P 88.3 kPa	x
V 441 L	441L
T	

$$P_1V_1 = P_2V_2$$

$$(88.3\text{kPa})(441\text{L}) = x\,(441\text{L})$$

$x = 88.3$ kPa

Since volume and temp remained constant the pressure will not change either

12. Calculate the relative rates of diffusion of nitrogen gas (N_2) and hydrogen gas (H_2).

a) What law is this? graham's law
b) What is the relationship? inverse
c) Solve the problem

$$\frac{\sqrt{N_2}}{\sqrt{H_2}} \quad \frac{\sqrt{28.02}}{\sqrt{2.016}} = 3.728$$

Hydrogen diffuses 3.728 times faster than Nitrogen.

13. Calculate the relative rates of methane gas (CH_4) and ammonia gas (NH_3).

a) What law is this? graham's law
b) What is the relationship? inverse
c) Solve the problem

$$\frac{\sqrt{NH_3}}{\sqrt{CH_4}} \quad \frac{\sqrt{17.034}}{\sqrt{16.042}} = 1.030$$

Methane diffuses 1.030 times faster than ammonia.

14. Calculate the volume occupied by 7.31 g CO_2 at 720 mm Hg and 27°C.

a) What law is this? ideal
b) Solve the problem

$$7.31\text{ g } CO_2 \left| \frac{1\text{ mol}}{44.01\text{ g}} \right. = 0.166\text{ mol}$$

P = 720 mm Hg
V = x
n = 0.166 mol
R = 62.4 $\frac{L\ mmHg}{mol\ K}$
T = 300 K

$$(720)(x) = (0.166)(62.4)(300k)$$

x = 4 L

15. Calculate the molar mass of a gas if 350 mL has a mass of 1.069 g at 40°C and 785 mm Hg.

a) What law is this? ideal w/ density
b) Solve the problem

$$D = \frac{m}{V} = \frac{1.069\text{ g}}{.35\text{ L}} = 3.1\text{ g/L}$$

D = 3.1 g/L
M = x
P = 785 mm Hg
R = 62.4 $\frac{L\ mmHg}{mol\ K}$
T = 313 K

$$3.1\text{ g/L} = \frac{x(785)}{(62.4)(313\text{ K})}$$

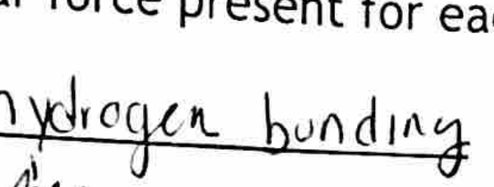
x = 77 g/mol

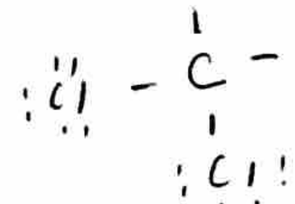
Intermolecular & Intramolecular Forces

16. The bonds within a molecule create an intramolecular (intermolecular/intramolecular) force, but the attraction between the molecules is an intermolecular (intermolecular/intramolecular) force. Intramolecular forces are stronger (stronger/weaker) than intermolecular forces.

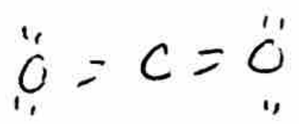
*when we melt something, do we break which forces break first? those are weaker.

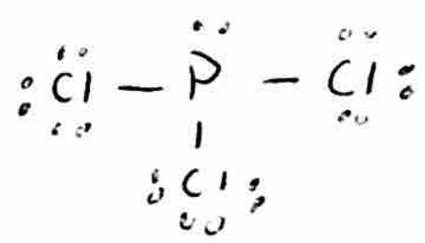
What is the strongest intermolecular force present for each of the following compounds?

17) water  hydrogen bonding

18) carbon tetrachloride  London dispersion

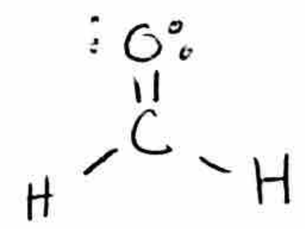
19) ammonia (NH_3) hydrogen bonding

20) carbon dioxide London dispersion 

21) phosphorus trichloride Dipole-Dipole 

22) nitrogen (N_2) London dispersion

23) ethane (C_2H_6) London dispersion * just C+H, always london dispersion

24) acetone (CH_2O) dipole-dipole 

25) methanol (CH_3OH) hydrogen bonding

26) borane (BH_3) london dispersion

27. Which would have the higher boiling point water or ammonia? → 18.016 → 17.034

water

→ both have hydrogen bonding so the tie breaker is molar mass

Kinetic Molecular Theory

List the 5 postulates of the Kinetic Molecular Theory. Then study them!!!

1.

2.

3. page 17 in your unit packet ☺

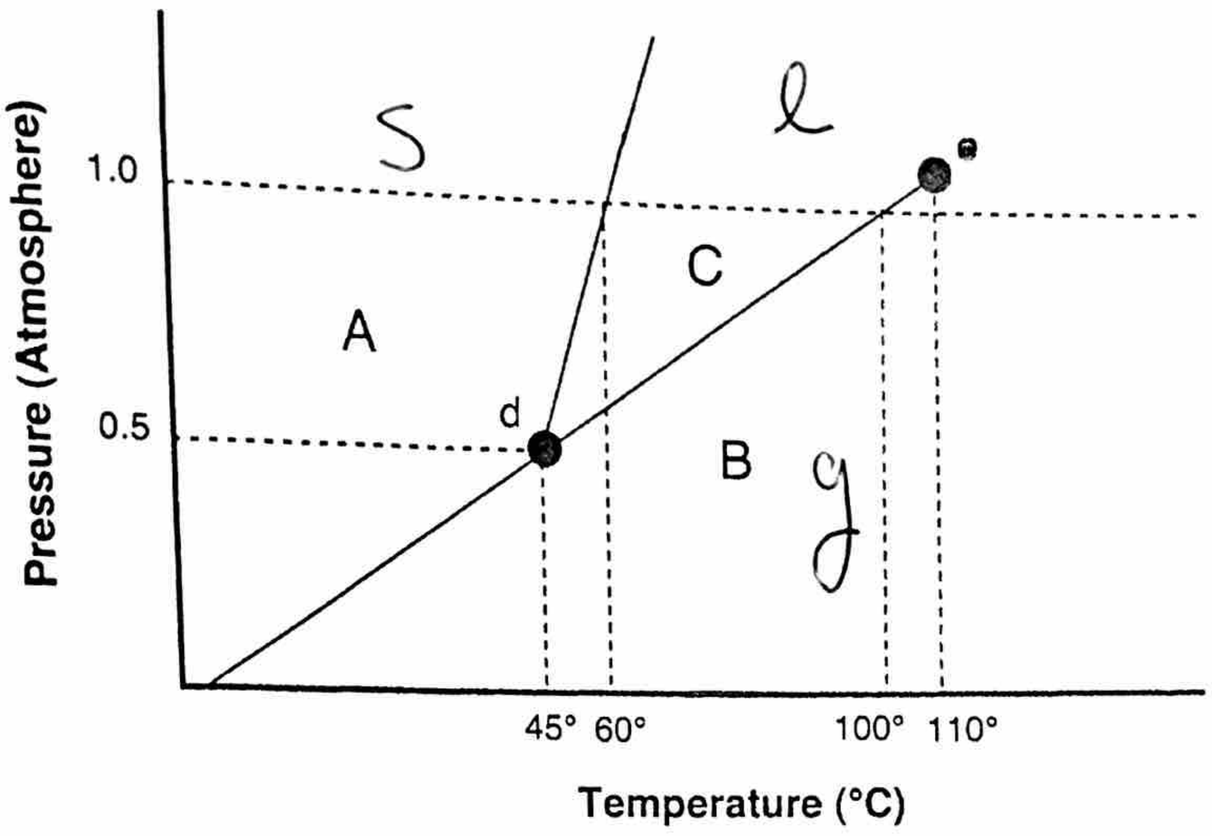
4.

5.

ASE DIAGRAM WORKSHEET

Part A – Generic Phase Diagram.

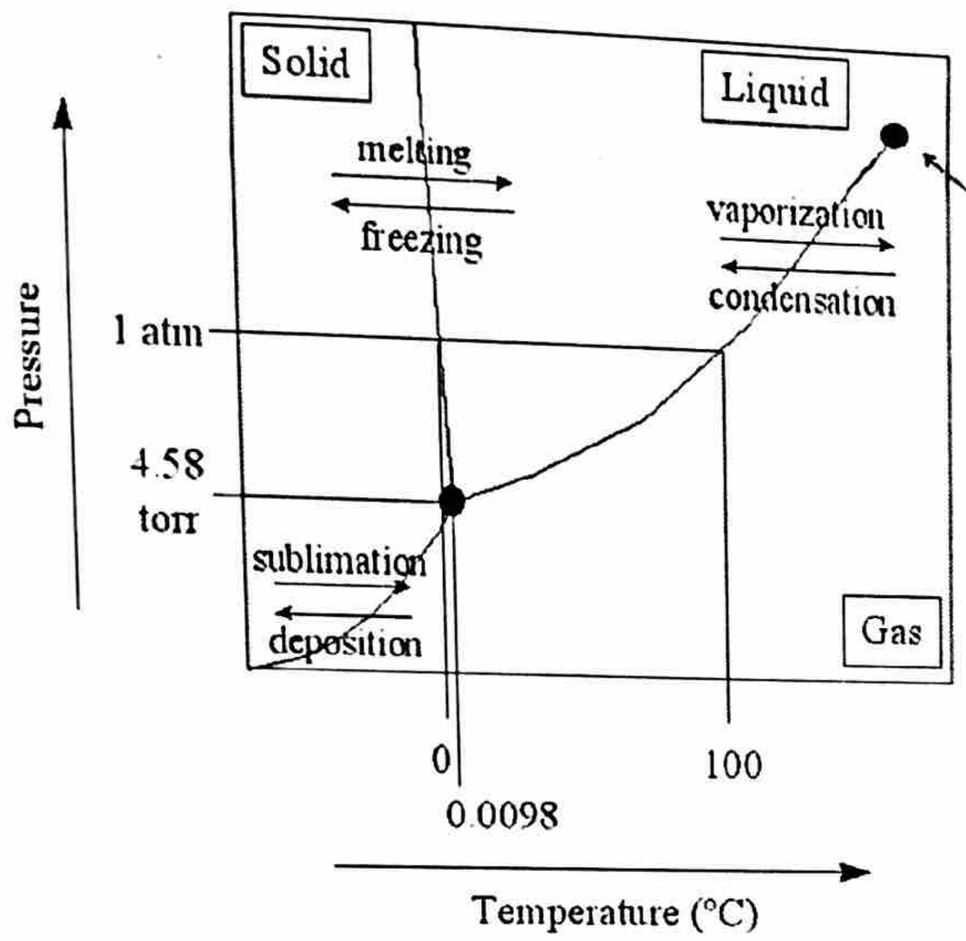
Answer the questions below in relation to the following generic phase diagram.



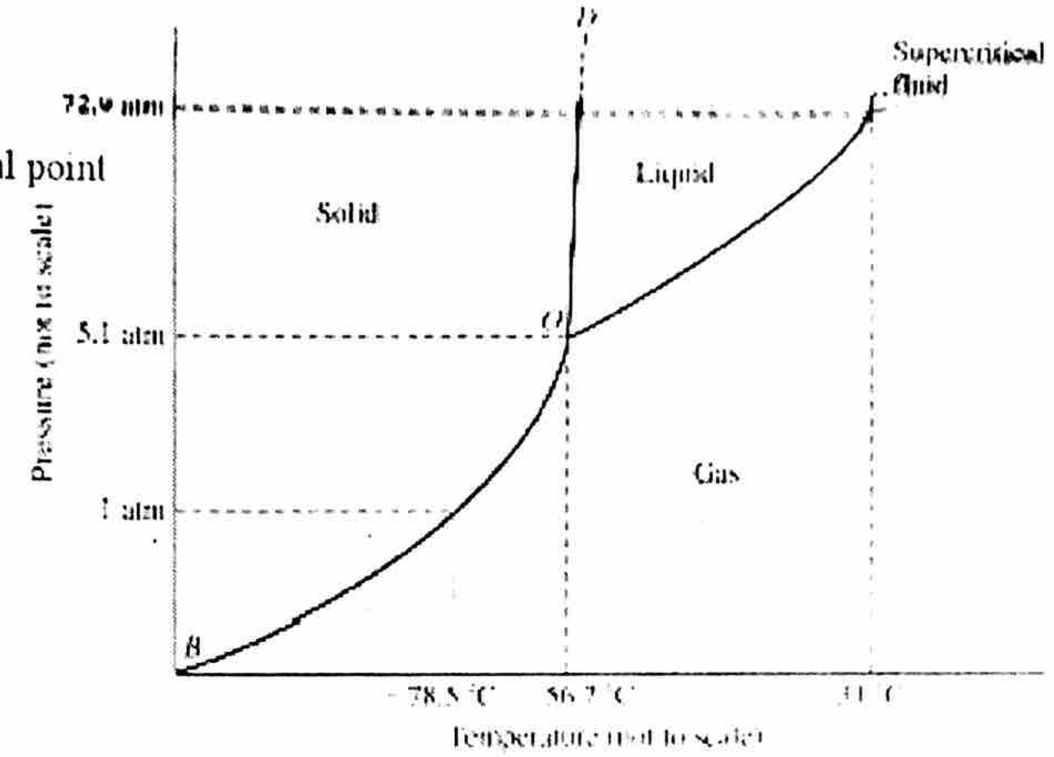
1. Which section represents the solid phase? A
2. What section represents the liquid phase? C
3. What section represents the gas phase? B
4. What letter represents the triple point? d In your own words, what is the definition of a triple point?
   a triple point is the exact pressure and temp that all 3 states of matter exist in equilibrium
5. What is this substance's normal melting point? 60°C
6. What is this substance's normal boiling point? 100°C
7. Above what temperature is it impossible to liquefy this substance, no matter what the pressure? 110°C
8. At what temperature and pressure do all three phases coexist? 0.5 atm, 45°C
9. At a constant temperature, what would you do to cause this substance to change from the liquid phase to the solid phase? increase pressure
10. What does sublimation mean?
    going from a solid to gas

ct B – **Which is which?**

***Phase* Diagram – 1** H_2O



Phase Diagram - 2 CO_2



11. What is the normal boiling point for phase diagram 1? 100°C

12. What is the name of the exothermic phase change between the solid and gas states of matter?
deposition → release energy (molecules slow down)

13. In Albuquerque, we live approximately 5,500 feet above sea level, which means the normal atmospheric pressure is less than 1 atm. In Albuquerque, will water freeze at a lower temperature or a higher temperature than at 1 atmosphere? higher Will water boil at a higher or lower temperature, than at 1 atmosphere? lower

14. At 1 atmosphere and room temperature (25°C), would you expect the solid represented in phase diagram 2, to melt to the liquid phase, or sublime to the gas phase? sublime

15. What is the normal freezing point for the substance in phase diagram 2? at standard pressure this substance will not freeze

16. Which phase diagram represents H_2O? 1

Which phase diagram represents CO_2? 2

How do you know? the equilibrium line between the solid and liquid phase has a negative slope (points towards y-axis) for water, and in the opposite direction for CO_2

New Material--This Will Also Be on The TEST!!!

Net Ionic Equations **http://tinyurl.com/owf6f37**

1. What 2 things must all net ionic equations have?

Charges + states of matter

2. For the reactions below predict the products, balance the reaction, include aq or s!, circle the precipitate and write the net ionic equation.

a. $K_3PO_4 + Al(NO_3)_3 \rightarrow$ $AlPO_{4(s)} + 3KNO_{3(aq)}$

$Al^{+3}_{(aq)} + PO_4^{-3}{}_{(aq)} \rightarrow AlPO_{4(s)}$

b. $BeI_2 + Cu_2SO_4 \rightarrow$ $BeSO_4 + 2CuI_{(aq)}$

(aq) NO RXN

Stoichiometry **https://www.youtube.com/watch?v=LQq203gyftA**

Given the following equation: $Na_2O + H_2O$ ---> 2 NaOH

3. What is the mole ratio of water to NaOH?

1 : 2

4. How many grams of NaOH is produced from 120 grams of Na_2O?

$$\frac{120\text{ g } Na_2O}{} \left| \frac{1\text{ mol } Na_2O}{61.98\text{ g } Na_2O} \right| \frac{2\text{ mol NaOH}}{1\text{ mol } Na_2O} \left| \frac{39.998\text{ g NaOH}}{1\text{ mol NaOH}} \right. = 150\text{ g NaOH}$$

5. How many grams of Na_2O are required to produce 160 grams of NaOH?

$$\frac{160\text{ g NaOH}}{} \left| \frac{1\text{ mol NaOH}}{39.998\text{ g NaOH}} \right| \frac{1\text{ mol } Na_2O}{2\text{ mol NaOH}} \left| \frac{61.98\text{ g } Na_2O}{1\text{ mol } Na_2O} \right. = 120\text{ g } Na_2O$$

Finding % of Water in Hydrates: **https://www.youtube.com/watch?v=dQ8BXI8ibuE**

Determine the percent of water in the following hydrates:

6. $CuSO_4*5H_2O$

$$\frac{5H_2O}{CuSO_4 \cdot 5H_2O} \times 100 = \frac{90.08}{249.7} \times 100 = 36.08\%$$

7. $Na_2CO_3*3H_2O$

$$\frac{3H_2O}{Na_2CO_3 \cdot 3H_2O} \times 100 = \frac{54.048}{160.038} \times 100 = 33.77\%$$