Dr. Zellmer | Chemistry 1250 | T, R
Time: 7 PM Sun. | Spring Semester 2022 | March 27, 2022
40 min | Quiz VIII

Name ____________________________ Rec. TA/time ____________________________

Show **ALL** your work or **EXPLAIN** to receive full credit.

1. Recall the van der Waal's equation and the significance of the constants a and b.

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

Values of the van der Waal's constants are determined for two gases and given in the table below.

gas	a (atm·L/mol^2)	b (L/mol)
A	30.53	0.102
B	0.134	0.143

Which of the following statements is **FALSE**?

a) Ideal gases conform to the postulates of the Kinetic Molecular Theory and follow the Ideal Gas Law.
b) Deviations from ideal behavior of gases are most likely at high pressures and low temperatures.
c) At high pressures gas A will exhibit larger positive deviations from ideality than gas B.
d) Gas A has stronger intermolecular forces than gas B.

2. (3 pts) Which of the following compounds is **INCORRECTLY** paired with the intermolecular forces that exist between neighboring molecules?

a) PF_5 London forces only

b) $AsCl_3$ London forces, dipole-dipole forces

c) $SiCl_4$ London forces only

d) CH_3CH_2F London forces, dipole-dipole forces

e) $CH_3C(=O)CH_3$ London forces, dipole-dipole forces, hydrogen bonding

3. (8 pts) Examine the following compounds and then answer the questions below which refer to these compounds, as pure substances. (**<u>Give a short explanation for your choices</u>**, i.e, types of **attractive forces**, whether **polar** or **nonpolar**, etc.)
(At. no.: H = 1, B = 5, C = 6, N = 7, F = 9, Al = 13, Si=14, P = 15, S = 16, Cl = 17)
(Group no.: H = 1A, B,Al = 3A, C,Si = 4A, N,P = 5A, O,S = 6A, F,Cl,Br,I = 7A)
(At. Wts.: H = 1.01, B = 10.81, C = 12.01, N = 14.01, O = 16.00, F = 19.00, Al = 26.98, Si = 28.09, P = 30.97, S = 32.07, Cl = 35.45)

C_3H_8 $\qquad$ $CH_3CH_2 - \underset{\cdot\cdot}{\ddot{O}} - H$ $\qquad$ $CH_3 - \underset{\cdot\cdot}{\ddot{O}} - CH_3$ $\qquad$ CH_2F_2

a) Which compound(s) has(have) **<u>only</u> London forces**?

b) Which compound(s) has(have) **<u>Dipole-Dipole</u>** forces?

c) Which compound(s) can form **H-bonds** between molecules (as a pure substance)?

d) Which compound should have the **<u>highest</u>** heat of vaporization, ΔH_{vap}?

4. Which of the following statements is **<u>FALSE</u>**?

a) NF_3 has a permanent **dipole moment**.

b) PCl_5 has a **<u>lower</u> surface tension** than CCl_4 at the same temperature.

c) CH_3F has **stronger** total **intermolecular forces** than BH_3.

d) O_2 has a **<u>greater</u> vapor pressure** at a specified temperature than CH_3F.

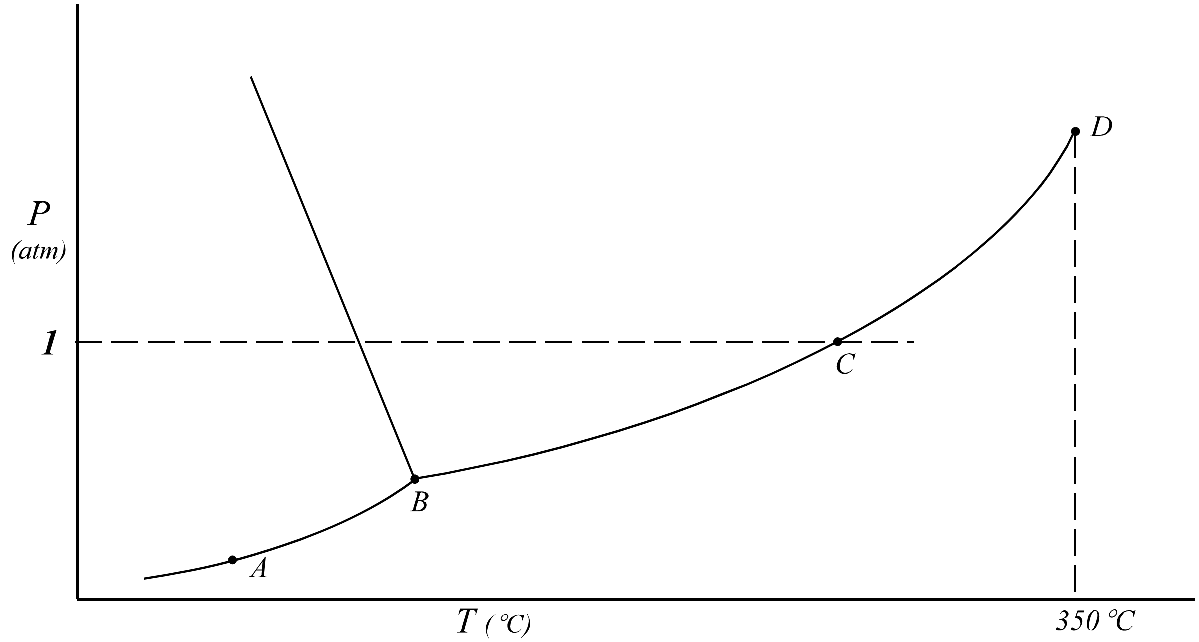
e) HF has a **<u>higher</u> boiling point** than PH_3.

5. (5 pts) Calculate the amount of heat (kJ) required to heat 125 g of mercury (Hg) from 25.0 ºC to its boiling point (357 ºC) and then vaporize it? (specific heat of liquid Hg = 0.138 J/g•ºC, ΔH_{vap} = 292 J/g)

a) 42.2 kJ b) 47.4 kJ c) 30.8 kJ d) 36.5 kJ e) 5.73 kJ

6. (6 pts) A substance has a ΔH_v = 20.0 kJ/mol. It has a vapor pressure of 0.800 atm at -2.00 ºC. What is it's **normal boiling point**?

7. (5 pts) The following is a phase diagram for an unknown substance. **Label** the regions (**phases**) **<u>AND</u>** write what points **A-D** represent (1 or 2 sentences next to the letters listed below). For letter **E** answer the question given there and give a brief explanation.



A.

B.

C.

D.

E. Which phase is **<u>MORE</u>** dense (circle answer and **explain**)? solid or liquid

8. (5 pts) It would be helpful to sketch a phase diagram for an imaginary compound (the points are already plotted for you):

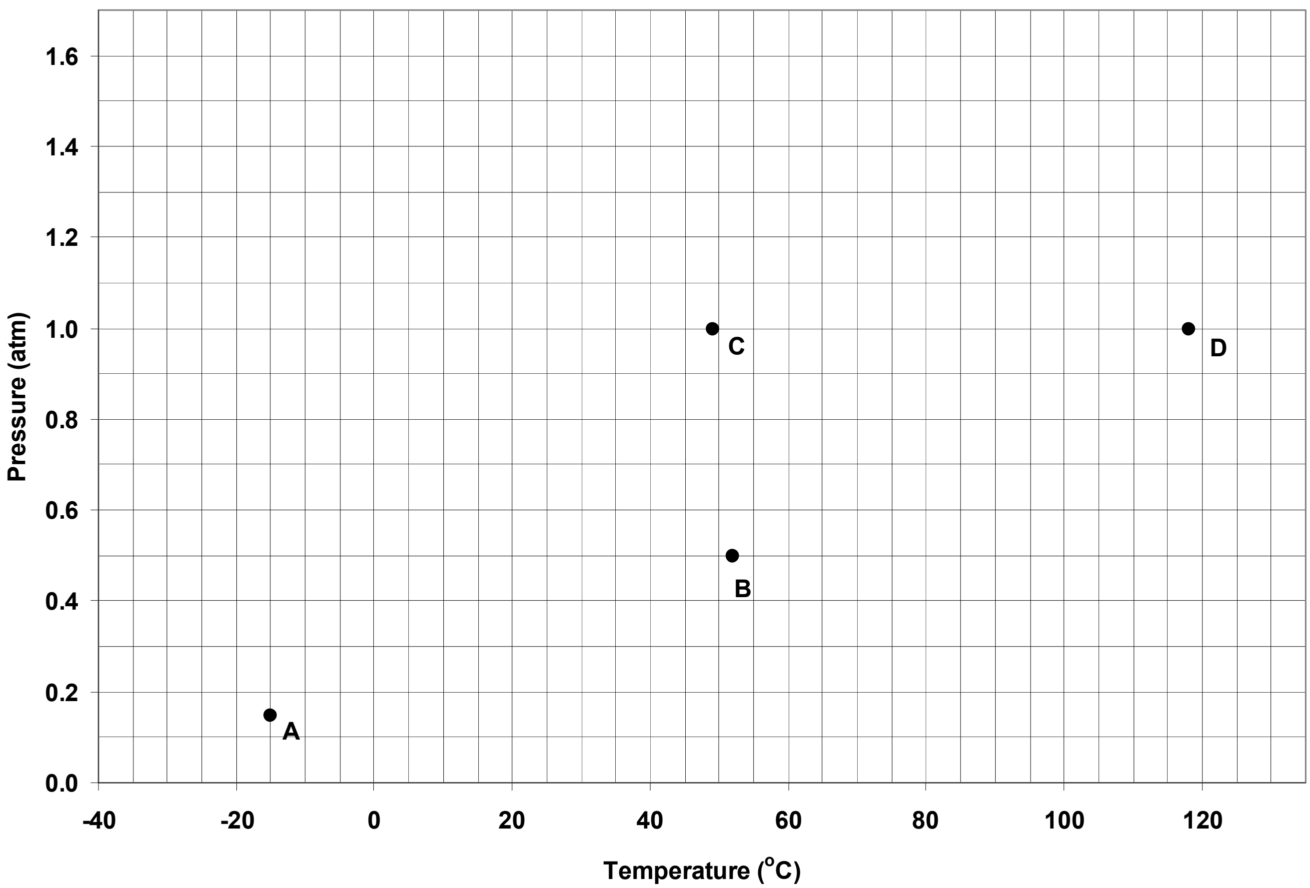
triple point = 52 ºC, 0.5 atm

critical point = 329 ºC, 5.8 atm (not shown)

normal melting point = 49 ºC

normal boiling point = 118 ºC

vapor pressure of solid at -15 ºC = 0.15 atm



Which of the following statements is **<u>INCORRECT</u>** about the compound?

a) **Increasing** the **temperature** from 0ºC to 60ºC at 0.7 atm will cause **fusion** to occur.

b) The solid is **less** dense than the liquid.

c) The solid **can** melt at temperatures below 49ºC when the **pressure** is **increased**.

d) **Condensation** occurs if the pressure is increased from 0.1 atm to 0.5 atm at 0ºC.

e) The solid will **sublime** rather than melt when the temperature is **raised** if the **pressure** is **0.3** atm.

9. (7 pts) A metal crystalizes in a body-centered-cubic unit cell with an atomic radius of 2.20 Å and a density of 3.48 g/cm^3. (1 Å = 1 x 10^{-8} cm, N_A = 6.02 x 10^{23})

(a) What is the atomic weight of the metal?

(b) What is the coordination number of the metal atom in this structure?

10. Choose the member of each of the following pairs that are expected to have the **<u>HIGHER</u>** normal melting point.

SiC or NaCl HF or Na W or Bi Al_2O_3 or NaCl

a) NaCl	HF	Bi	Al_2O_3
b) NaCl	Na	W	NaCl
c) SiC	HF	W	NaCl
d) SiC	Na	Bi	Al_2O_3
e) SiC	Na	W	Al_2O_3

USEFUL INFORMATION

R = 0.08206 L-atm/mol-K = 8.3145 J/mol-K

Avogadro's number = 6.02×10^{23} particles/mole

$1\ \text{Å} = 1 \times 10^{-10}\ \text{m} = 1 \times 10^{-8}\ \text{cm}$

molar volume at STP = 22.41L

$KE = \frac{1}{2} mv^2$, $KE_{avg} = \frac{1}{2} mu^2$, total average KE per mole = 3/2 RT

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 **H** 1																	4.003 **He** 2
2	6.941 **Li** 3	9.012 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.007 **N** 7	15.999 **O** 8	18.998 **F** 9	20.179 **Ne** 10
3	22.990 **Na** 11	24.305 **Mg** 12											26.98 **Al** 13	28.09 **Si** 14	30.974 **P** 15	32.06 **S** 16	35.453 **Cl** 17	39.948 **Ar** 18
4	39.098 **K** 19	40.08 **Ca** 20	44.96 **Sc** 21	47.88 **Ti** 22	50.94 **V** 23	52.00 **Cr** 24	54.94 **Mn** 25	55.85 **Fe** 26	58.93 **Co** 27	58.69 **Ni** 28	63.546 **Cu** 29	65.38 **Zn** 30	69.72 **Ga** 31	72.59 **Ge** 32	74.92 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
5	85.47 **Rb** 37	87.62 **Sr** 38	88.91 **Y** 39	91.22 **Zr** 40	92.91 **Nb** 41	95.94 **Mo** 42	98 **Tc** 43	101.07 **Ru** 44	102.91 **Rh** 45	106.42 **Pd** 46	107.87 **Ag** 47	112.41 **Cd** 48	114.82 **In** 49	118.69 **Sn** 50	121.75 **Sb** 51	127.60 **Te** 52	126.90 **I** 53	131.39 **Xe** 54
6	132.91 **Cs** 55	137.33 **Ba** 56	138.91 **La** 57	178.39 **Hf** 72	180.95 **Ta** 73	183.85 **W** 74	186.21 **Re** 75	190.23 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.97 **Au** 79	200.59 **Hg** 80	204.38 **Tl** 81	207.2 **Pb** 82	208.98 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
7	223 **Fr** 87	226.03 **Ra** 88	227.03 **Ac** 89	261 **Rf** 104	262 **Ha** 105	263 **Sg** 106	262 **Ns** 107	265 **Hs** 108	266 **Mt** 109	269 110	272 111	277 112						

Lanthanide Series	140.12 **Ce** 58	140.91 **Pr** 59	144.24 **Nd** 60	145 **Pm** 61	150.36 **Sm** 62	151.96 **Eu** 63	157.25 **Gd** 64	158.93 **Tb** 65	162.50 **Dy** 66	164.93 **Ho** 67	167.26 **Er** 68	168.93 **Tm** 69	173.04 **Yb** 70	173.04 **Lu** 71
Actinide Series	232.04 **Th** 90	231.04 **Pa** 91	238.03 **U** 92	237.05 **Np** 93	**Pu** 94	**Am** 95	**Cm** 96	**Bk** 97	**Cf** 98	**Es** 99	**Fm** 100	**Md** 101	**No** 102	**Lr** 103

A PERIODIC CHART OF THE ELEMENTS
(Based on ^{12}C)