NAME_____

S2019/CHEM1451/Quiz 2/ 30 Points

Jan 24, 2019

Multiple Choice: (3 Pts Each) Write the letter associated with the correct answer in the blank provided.

B 1. The normal boiling point for H_2Se is higher than the normal boiling point for H_2S. This can be explained by

a) larger dipole-dipole forces for H_2Se.
b) larger dispersion forces for H_2Se.
c) larger hydrogen-bond forces for H_2Se.
d) larger dipole-dipole forces, larger dispersion forces, and larger hydrogen-bond forces for H_2Se.

so, H_2Se has >IMF

H-Ẍ-H

↑Both, but Se has many more e⁻.

D 2. Which of the following statements is FALSE?

a) The rate of vaporization increases with increasing surface area. ✓
b) The rate of vaporization increases with decreasing strength of intermolecular forces. ✓
c) The rate of vaporization increases with increasing temperature. ✓
d) Molecules with hydrogen bonding are more volatile than compounds with dipole-dipole forces. ✗
e) None of the above are false.

A 3. Which substance below has the strongest intermolecular forces?

a) A_2X, ΔH_{vap}= 39.6 kJ/mol
b) BY_2, ΔH_{vap}= 26.7 kJ/mol
c) C_3X_2, ΔH_{vap}= 36.4 kJ/mol
d) DX_2, ΔH_{vap}= 23.3 kJ/mol
e) EY_3, ΔH_{vap}= 21.5 kJ/mol

E 4. Place the following substances in order of **increasing** boiling point.

Ne Cl_2 O_2

smallest … largest

Highest BP ⇒ largest IMF

All are non-polar, so only Dispersion Forces

a) $Ne < Cl_2 < O_2$
b) $Cl_2 < O_2 < Ne$
c) $O_2 < Cl_2 < Ne$
d) $Cl_2 < Ne < O_2$
e) $Ne < O_2 < Cl_2$

D 5. Place the following substances in order of **increasing** vapor pressure at a given temperature.

Non-polar

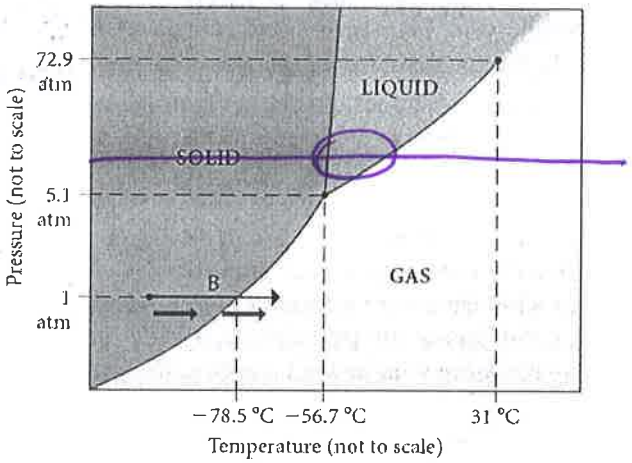
SF_6 SiH_4 SF_4 ← polar, so smallest VP

↖ Non-polar

largest VP ⇒ smallest IMF

a) $SF_6 < SiH_4 < SF_4$
b) $SiH_4 < SF_4 < SF_6$
c) $SF_6 < SF_4 < SiH_4$
d) $SF_4 < SF_6 < SiH_4$ ← of these, SF_6 is larger, so higer IMF, smaller VP
e) $SiH_4 < SF_6 < SF_4$

B 6. Consider the phase diagram shown. Choose the statement below that is TRUE.



-56.7°C

a) The triple point of this substance occurs at a temperature of ~~31~~ °C.
b) At 10 atm of pressure, there are temperatures where the liquid phase of this substance would exist. ✓
c) The solid phase of this substance is ~~lower~~ higher in density than the liquid phase.
d) Following arrow B would cause the substance to ~~boil~~ sublime.
e) None of the above are true.

Solid/liquid boundary points to less dense

$T_1 = 35 + 273 = 308\,K$

1. (6 Points) Determine the normal boiling point of a substance whose vapor pressure is 55.1 mm Hg at 35°C and has a ΔH_{vap} of 32 .1 kJ/mol. (P_1)

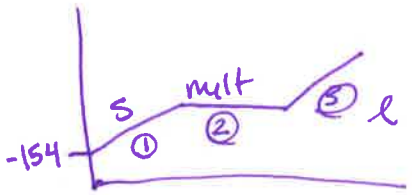
$$\ln\frac{P_1}{P_2} = \frac{-\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln\left(\frac{760}{55.1}\right) = 2.624 = \frac{-32{,}100\ J/mol}{8.314\ J/K\cdot mol}\left(\frac{1}{T_2} - \frac{1}{308}\right) \leftarrow +4$$

$$T_2 = 389.5K \text{ or } 390K$$

2. (6 Points) How much energy is required to heat 87.1 g acetone (molar mass=58.08 g/mol) from a solid at -154.0°C to a liquid at -42.0°C? The following physical data may be useful. (Sketching a heat curve would help with solving this problem.)

ΔH_{fus} = 7.27 kJ/mol
C_{liq} = 2.16 J/g°C
C_{gas} = 1.29 J/g°C
C_{sol} = 1.65 J/g°C
$T_{melting}$ = -95.0°C



① $q = mC\Delta T$ (59)
$= 87.1g(1.65\ J/g\cdot°C)(-95 - -154)$
$= 8479.19\ J$

② $q = \frac{87.1g}{58.08\ g/mol} \cdot 7270\ J/mol = 10902.5\ J$ (53)

③ $q = 87.1g(2.16)(-42 - -96) = 9971.2\ J$

Sum = 29352.9 J = **29.3kJ**

The Periodic Table of the Elements

1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050											13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.96655	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

1995 IUPAC masses and Approved Names from http://www.chem.qmw.ac.uk/iupac/AtWt/
masses for 107-111 from C&EN, March 13, 1995, p. 35
112 from http://www.gsi.de/z112e.html

$R = 8.314\ \frac{J}{K \cdot mol}$

$$\ln P_{vap} = \frac{-\Delta H_{vap}}{R}\left(\frac{1}{T}\right) + \ln B$$

(B: constant)

C-C equation

$$\ln \frac{P_2}{P_1} = \frac{-\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

(2-point form)