

$$\bar{x} = 65\% \quad \text{Top Mark} = 103\%$$

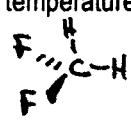
CHEMISTRY 121 MIDTERM 3

Nov. 24, 2006

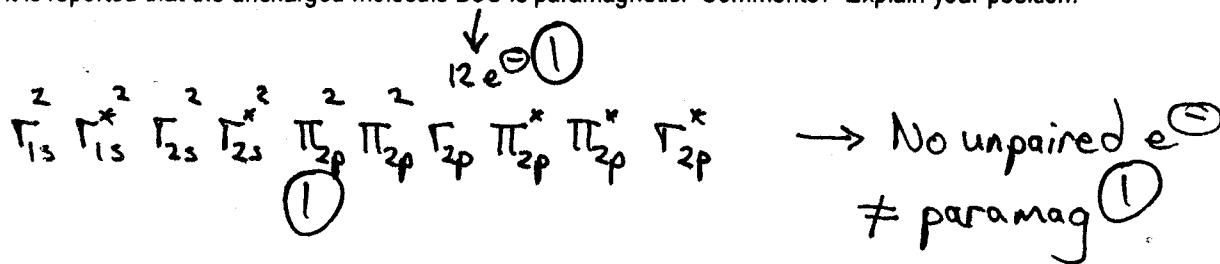
Unless otherwise stated, show all your reasoning/work for full marks

(5) 1) Answer true (T) or false (F) on the line provided.

- | | |
|------------------------------------------------------------------------------------------|----------|
| a) The molecular orbital theory explains the <u>diamagnetism</u> of O ₂ . | <u>F</u> |
| b) Moving isopiesticly on a phase diagram means increasing temperature. | <u>F</u> |
| c) Hydrogen bonding is a strong intermolecular force in CH ₂ F ₂ . | <u>F</u> |
| d) SeO crystallizes in the zinc blende structure. 1:1 ✓ | <u>T</u> |
| e) Equal moles of gases at constant T and P have equal volumes. ✓ | <u>T</u> |



(3) 2) It is reported that the uncharged molecule BeO is paramagnetic. Comments? Explain your position.



(4) 3) Chlorine gas (6.19 g, FW = 70.9 g/mol) at 20 °C and 2.1 atm pressure is completely transferred into a reaction chamber of 2300 cm³ and afterwards having 1 atm pressure. Calculate the temperature (°C) in the reaction chamber.

$$Cl_2 = \frac{6.19 \text{ g}}{70.9 \text{ g/mol}} = 8.73 \times 10^{-2} \text{ mol} \quad (1)$$

$$PV = nRT$$

$$(2.1)(V) = (0.0873)(0.08206)(293)$$

$$V = 1 \text{ L} \quad (1)$$

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

$$\frac{(2.1)(1)}{293} = \frac{(1)(2.3 \text{ L})}{T_2} \quad (1)$$

$$T_2 = 321 \text{ K}$$

$= 4.8 \times 10^1 \text{ } ^\circ \text{C} \quad (1)$

(-1/2) SF
 (-1/2) ans in K
 (-1/2) ans = 47 °C or 320
 (-1) ans = way off

(4) 4) Calculate the % volume in an fcc unit cell which is occupied by atoms. Circle the right answer. $\pi = 3.14$, $V_{\text{sphere}} = \frac{4}{3}\pi r^3$

74.10%

73.99%

74.01% (1)

74.04%

74%

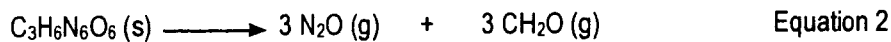
$$V = a^3$$

$$V_{\text{sph.}} = \left(\frac{4}{3}\pi r^3\right) (4 \text{ atoms})$$
 In fcc $\Rightarrow (4r)^2 = 2a^2$
 $4r = \sqrt{2}a$
 $r = \frac{\sqrt{2}a}{4}$

$$V = .7401 a^3$$

$$V = \frac{4}{3}\pi r^3$$

(5) 5) Plastic explosive RDX ($\text{C}_3\text{H}_6\text{N}_6\text{O}_6$ - FW = 222 g/mol) "reacts" according to only one of the balanced equations below.



In a 6.022 liter indestructible test chamber, RDX (2.42 kg) explodes and produces a pressure of 511 atm at 300 °C. Do the calculations and determine which equation represents the explosion of RDX.

$$\frac{2420 \text{ g RDX}}{222 \text{ g/mol}} = 1.09 \times 10^1 \text{ mol RDX produces either}$$

$\times 9 \rightarrow$ moles products = 9.81×10^1 (1)
 $\times 6 \rightarrow$ moles products = 6.54×10^1 (1)

From conditions of $P = 511 \text{ atm}$
 $T = (300 + 273.15) \text{ K}$
 $R = .08206 \text{ Latm/mol K}$
 $V = 6.022 \text{ L}$

Can calc. moles of products
 * too many students said that 1g = 1000kg.

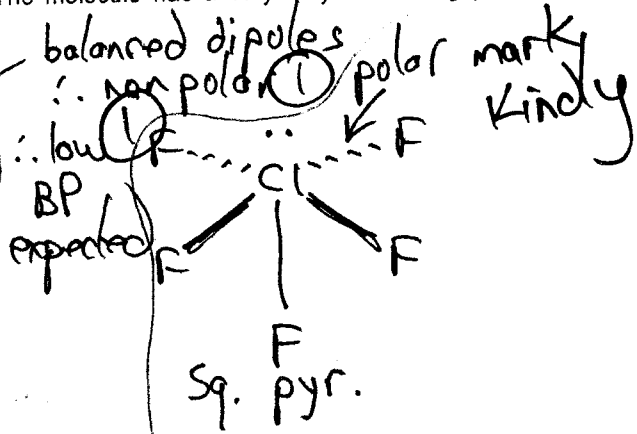
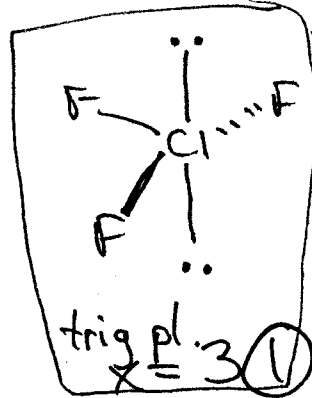
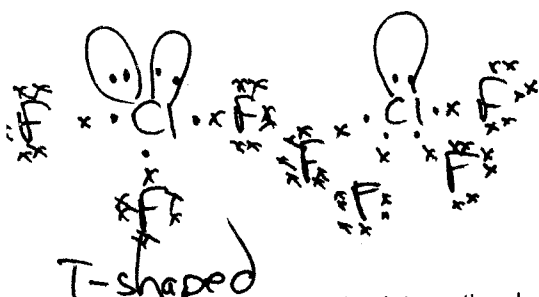
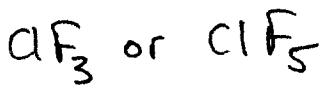
$$PV = nRT$$

$$(511)(6.022) = n(.08206)(573.15)$$

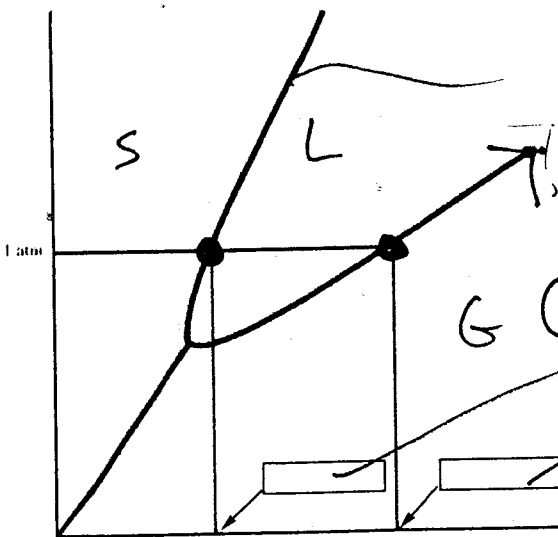
$$n = 6.54 \times 10^1$$

$\therefore \text{Eq 2 (1)}$

- (3) 6) A molecule has the formula of ClF_x . The value of X is 3 or 5. The molecule has a very very low boiling point. Determine the value of X and account for the data.



- (3) 7) Label the arrowed points on the phase diagram. Discuss the implications of the slope of the solid-liquid line.



solid more dense than liquid (1)
 (As $P \uparrow$, T needed to melt also \uparrow
 \therefore more dense)

(1) MP (FP)
 (1) BP (Condens + Pt)

- (4) 8) Germanium (Ge) crystallizes in a fcc cubic cell but it also fills some of its tetrahedral holes with Ge atoms. Calculate the number of tetrahedral holes being filled. Explain. Edge length of cell = 565 pm, Density of Ge = 5.36 g/cm³

$D = \frac{M}{V}$

$$\frac{5.36 \text{ g}}{\text{cm}^3} = \frac{72.59 \text{ g} \times \frac{1 \text{ mol}}{6.022 \times 10^{23}} \times (4+x)}{(565 \times 10^{-12} \text{ m} \times 100)^3}$$

Let $x =$ Ge atoms in tet. holes

$8 = 4 + x$

$x = 4$ (1)

- (1) Bonus. What end of the spectrum of light can't bees see? Red (1)