

Chemistry 102 Test #1 KEY average±st dev = 87 ± 23 (58%±16

(1)

Category	a) SF <sub>4</sub> (see p. 390 of textbook, Fig.9.6)	b) SO <sub>4</sub> <sup>2-</sup> (see p. 388 of book, Fig.9.5)	c) NO <sub>2</sub> (see p. 388 of book, Fig.9.5)	d) BrF <sub>5</sub> (see p. 390 of textbook, Fig.9.6)	e) ClF <sub>3</sub> (see p. 390 of textbook, Fig.9.6)
(# valence e's)	(34)	(32)	(17e)	(42)	(28)
e pair geo- metry	Trigonal bipyramidal	Tetrahedral	Trigonal planar	Octahedr al	Trig. bipyramidal
Molec geometry	seesaw	Tetrahedral	Angular or bent	Square pyramidal	T-shaped
Angles°	90°, 120°,180°	109.5°	120°	90°	90°, 120°
hybridiz'n	sp <sup>3</sup> d	sp <sup>3</sup>	sp <sup>2</sup>	sp <sup>3</sup> d <sup>2</sup>	sp <sup>3</sup> d
Unusual?	Exceeds octet	Exceeds octet	Is a radical	Exceeds octet	Exceeds octet

(2) a)

The constant a depends on the intermolecular attraction between molecules. The more polar, the greater a is. XeF<sub>4</sub> has 36e's, its square planar, non polar. ClF<sub>5</sub> has 42 e's, it's trig bipyramidal, it's polar so ClF<sub>5</sub> has a higher a constant.

b) The constant b depends on the size of the molecule. XeF<sub>4</sub> has a larger diameter (due to Xe) than ClF<sub>5</sub> so expect XeF<sub>4</sub> to have higher b. The molar mass of XeF<sub>4</sub> > ClF<sub>5</sub> also causing to be the case.

(3) . H- $\ddot{\text{N}}=\text{C}=\ddot{\text{O}}$ :

C-N bond: $\sigma$ bond =overlap N's sp <sup>2</sup> & C's sp orbitals	C-O bond: $\sigma$ bond =overlap O's sp <sup>2</sup> & C's sp orbitals
$\pi$ bond = overlap N's p & C's p orbitals	$\pi$ bond = overlap O's p & C's p orbitals

(4)

Solution: density (d) = mass (m) / volume (V). But m = n M<sub>w</sub>

so d = nM<sub>w</sub>/V

from ideal gas eq: pV = nRT or n/V = p/RT substituting in expression for d:

$$d = pM_w/RT$$

b)

Solution: You can solve it in two ways,

(A) As in the textbook: first, get an average MW: get the molar fraction, X:

$$X_{\text{CH}} = (0.074)/(0.074+0.050)=0.597;$$

$$X_{\text{Cl}}=1-0.597=0.403;$$

Next get the average MW based on the weighted average:

$$\text{So } M_{w,\text{ave}} = .597(26.0)+.403(70.9)=44.09 \text{ g/mol}$$

So  $d = nM_w/V = 0.124 \text{ mol}(44.09 \text{ g/mol})/1.50 \text{ L} = 3.64 \text{ g/L}$

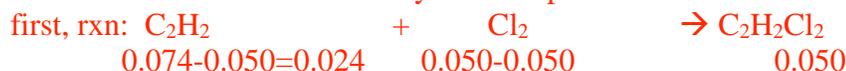
(B) Easier: Just add up all the masses and divide by the volume:

$$d = \text{mass/vol} = \frac{(0.074 \text{ mol C}_2\text{H}_2)(26.0 \text{ g/mol}) + (0.050 \text{ mol Cl}_2)(70.9 \text{ g/mol})}{1.50 \text{ L}} = \frac{1.92 + 3.64}{1.50} = 3.64$$

b) Solution:  $p = nRT/V = (.124 \text{ mol})(.0821 \text{ atmL/molK})(300 \text{ K})/(1.50 \text{ L}) = 2.04 \text{ atm}$  (where  $n = n_{\text{CH}} + n_{\text{Cl}}$ )

C Solution:

First, study the reaction and decide on the limiting reagent. See how many moles of gases remains and use that to calculate your final pressure.



total mol remaining:  $n = 0.024 + 0.050 = 0.074$ ;  $p = nRT/V = (0.074)(.0821)(723)/2.50 = 1.76 \text{ atm}$

(5) a)

Answer:  $\text{O}_3 + h\nu \rightarrow \text{O}_2 + \cdot\text{O}$



b) Answer:

The approach here is to realize that we have 2 unknowns to start with.  $P_{\text{O}_2}$  and  $P_{\text{O}_3}$ . After the reaction, the  $P_{\text{O}_3}$  becomes additional  $P_{\text{O}_2}$ . The next thing to realize is that according to Avogadro's law, P is proportional to n. So we can write:

Let  $x = P_{\text{O}_2}^1$   $y = P_{\text{O}_3}^1$  so  $x + y = 5.0$  (equation (i))

(i) The photolysis reaction of ozone:



Or  $P_{\text{O}_2}' = \frac{3}{2}P_{\text{O}_3}$  so we under final conditions:

$$P_{\text{O}_2} + P_{\text{O}_2}' = 6.0 \quad \text{or} \quad x + \left(\frac{3}{2}\right)y = 6.0 \quad (\text{eq. (ii)})$$

therefore: (ii)-(i):  $0.5 y = 1 \text{ atm} \Rightarrow y = 2 = P_{\text{O}_3}$  and  $x = 3 \text{ atm} = P_{\text{O}_2}$

c) answer: The # moles of  $\text{O}_2 + \text{O}_3$  originally present can be solved by the ideal gas equation:

$$pV = nRT \Rightarrow n = pV/RT = (5.0 \text{ atm})(3.0 \text{ L}) / (0.0821 \text{ atmL/molK})(300 \text{ K}) = 0.609 \text{ moles.}$$

d) answer: Draw the structures of  $\text{O}_2$  and  $\text{O}_3$  and show 3 kinds of interactions:

