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

(1)

Category	a) SF_4 (see p. 390 of textbook, Fig.9.6)	b) SO_4^{2-} (see p. 388 of book, Fig.9.5)	c) NO_2 (see p. 388 of book, Fig.9.5)	d) BrF_5 (see p. 390 of textbook, Fig.9.6)	e) ClF_3 (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	Octahedral	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^3d	sp^3	sp^2	sp^3d^2	sp^3d
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_4 has 36e's, its square planar, non polar. ClF_5 has 42 e's, it's trig bipyramidal, it's polar so ClF_5 has a higher **a** constant.

b) The constant b depends on the size of the molecule. XeF_4 has a larger diameter (due to Xe) than ClF_5 so expect XeF_4 to have higher **b**. The molar mass of $XeF_4 > ClF_5$ also causing to be the case.

(3) . H-¨N=C=Ö:

C-N bond: σ bond =overlap N's sp^2 & C's sp orbitals	C-O bond: σ bond =overlap O's sp^2 & C's sp orbitals
π bond = overlap N's p & C's p orbitals	π bond = overlap O's p & C's p orbitals

(4)
Solution: density (d) = mass (m) / volume (V). But $m = n M_w$
so $d = nM_w/V$
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:
$X_{CH} = (0.074)/(0.074+0.050)=0.597$;
$X_{Cl}=1-0.597=0.403$;
Next get the average MW based on the weighted average:
So $M_{w,ave} = .597(26.0)+.403(70.9)=44.09$ g/mol

So d= nM_w/V=0.124mol(44.09g/mol)/1.50 L =3.64 g/L

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

$$d = \text{mass/vol} = \frac{(0.074\text{mol } C_2H_2)(26.0\text{g/mol})+(0.050\text{ mol } Cl_2)(70.9\text{g/mol})}{1.50\text{ L}} = \frac{1.92+3.64}{1.50} = 3.64$$

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

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

first, rxn: C_2H_2	+	Cl_2	→	$C_2H_2Cl_2$
0.074-0.050=0.024		0.050-0.050		0.050

total mol remaining: n=.024+.050 = .074; p= nRT/V=(.074)(.0821)(723)/2.50=1.76atm

(5) a)
Answer: $O_3 + hv \rightarrow O_2 + .O.$

$\underline{O_3 + .O. \rightarrow 2\ O_2}$

$2\ O_3 \rightarrow 3\ O_2$ (net destruction of O_3 to O_2) (see also page 463)

b) Answer:
The approach here is to realize that we have 2 unknowns to start with. P_{O2} and P_{O3} . After the reaction, the P_{O3} becomes additional P_{O2}. The next thing to realize is that according to Avogadro's law, P is proportional to n. So we can write:

Let x = $P_{O2}{}^1$ y= $P_{O3}{}^1$ so x+y = 5.0 (equation (i))

(i) The photolysis reaction of ozone:

$$2O_3 \xrightarrow{hv} 3O_2$$

y (added $P_{O2} = P_{O2}'$)

Or $P_{O2}' = \frac{3}{2}P_{O3}$ so we under final conditions:

$P_{O2} + P_{O2}' = 6.0$ or $x + (\frac{3}{2})y = 6.0$ (eq.(ii))

therefore: (ii)-(i) : 0.5 y = 1 atm = > y=2 = P_{O3} and x = 3 atm = P_{O2}

c) answer: The # moles of O_2+O_3 originally present can be solved by the ideal gas equation:
pV = nRT => n = pV/RT = (5.0 atm)(3.0L)/(0.0821 atmL/molK)(300K) = 0.609 moles.

d) answer: Draw the structures of O_2 and O_3 and show 3 kinds of interactions:

dipole-dipole

:O=Ö-Ö: - - - :O=Ö-Ö:

dipole-induced dipole

:O=O: - - - :O=Ö-Ö:

dispersion:

:O=O: - - - :O=O:

O_2 is closer to an ideal gas because it has weaker intermolecular interaction than O_3 which has a weak dipole moment.

(6) Let's inspect the nonideal gas equation: $(p+a(n/V)^2)(V-nb)=nRT$. The constant b is the correction to the empty space volume, V, and "nb" represents the "void volume" occupied by the molecules. The closest we can get to that is to consider the volume of the liquid (incompressible) as the void volume. Since n=#moles, b must be void volume/mole. So get the volume of 1 mole of liquid N_2 : d = 0.808g/mL and m = 28.0g

So V = m/d= 28.0 g/mol /0.808 g/mL = 34.6 mL/mol (1.00L/1000mL)=0.0346 L/mol

So b = .0346 L/mol (on page 461, it lists b for N_2 to be 0.0391 L/mol). Not bad for a quick estimate!

(7) Answer:

The main one are chlorofluorocarbons, CFC's, which need photons to dissociate :

$C_2F_2Cl_2$ + hv → $C_2F_2Cl.$ + Cl.

It's the Cl. that leads to the dissociation of ozone and this can happen at night.

Cl. + O_3 → ClO. + O_2

Catalysis can occur only if the Cl. is regenerated after it forms ClO. This is only possible if there are photons to complete the 4 steps involved in the role of CFC's in ozone dissociation.

(8) a) x= period y= boiling point

b)

methane ammonia hydrogenfluoride H_2O

lowest highest BP

c) It shows the great effect of H-bonding on the boiling point resulting in drastic rise in boiling points.