

I. 50 points

Three stable isotopes of oxygen exist: ^{16}O , ^{17}O , and ^{18}O , of which, ^{16}O is the most abundant natural isotope. Consider the differences in thermodynamic properties of the molecules $^{16}\text{O}_2$, $^{17}\text{O}_2$, and $^{16}\text{O}-^{18}\text{O}$. For all practical purposes, the electronic behavior of each molecule is the same. In Table I, circle the closest choice assuming ideal gases. The four choices are HIGHER, LOWER, DIFFER (which means different, but its not obvious whether its higher or lower) or SAME. Fill in Table I and turn it in!

A. 18 points (see Table I)

B. 18 points (see Table I)

C. 14 points

Provide your best estimate of the difference in entropy between $^{16}\text{O}-^{18}\text{O}$ and $^{17}\text{O}_2$ at 298°K and 1 atm pressure assuming ideal gases. Justify any major approximations you make.

II. 20 points

Assuming the partial molar enthalpy in a binary solution can be written:

$$\begin{aligned}\bar{h}_1 &= a_1 + b_1 x_2^2 \\ \bar{h}_2 &= a_2 + b_2 x_1^2\end{aligned}$$

A. How are b_1 and b_2 related?B. Find h_1° and h_2° (pure component enthalpies).C. Find Δh^{MIX} .

III. 30 points

Calculate the fugacity of pure liquid chloroform at 100°C and 100 atm. The density of liquid chloroform at 100°C is 1.4 gr/cm₃ and MW = 119.4 gr/mole. The vapor pressure of chloroform is given by:

$$\log_{10} P = \frac{-1638.86}{T(^{\circ}\text{K})} + 7.735083$$

where: P is in mmHg absolute (760 mmHg = 1 atm)

For chloroform, $T_c = 536.6$, $P_c = 54$ atm, $z_c = .294$, and $\omega = 0.216$.

Table I.

YOUR NAME: _____

Turn in with your exam.

B. For ^{16}O - ^{18}O Relative to $^{17}\text{O}_2$, Circle Below:	
Internal Energy	Translation Part - Higher Lower Differ Same
	Rotation Part - Higher Lower Differ Same
	Vibrational Part - Higher Lower Differ Same
	Total - Higher Lower Differ Same
Heat Capacity	Translation Part - Higher Lower Differ Same
	Rotation Part - Higher Lower Differ Same
	Vibrational Part - Higher Lower Differ Same
	Total - Higher Lower Differ Same
Entropy	Translation Part - Higher Lower Differ Same
	Rotation Part - Higher Lower Differ Same
	Vibrational Part - Higher Lower Differ Same
	Total - Higher Lower Differ Same