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A SIMPLE METHOD FOR LIQUID ENTHALPY DEPARTURE CALCULATIONS

BY

CHING-LIN CHIEN

A THESIS

PRESENTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE

OF

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

AT

NEWARK COLLEGE OF ENGINEERING

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Newark, New Jersey  
1971

APPROVAL OF THESIS

A SIMPLE METHOD FOR LIQUID ENTHALPY DEPARTURE CALCULATIONS

BY

CHING-LIN CHIEN

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DEPARTMENT OF CHEMICAL ENGINEERING

NEWARK COLLEGE OF ENGINEERING

BY

FACULTY COMMITTEE

APPROVED: \_\_\_\_\_  
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NEWARK, NEW JERSEY

SEPTEMBER, 1971

## Abstract

The reduced equation of state for gases and liquids developed by Benson and Golding in 1951 is modified and used to calculate liquid enthalpy departures for saturated pure substances and mixtures. The temperature-independent coefficients in the modified equation are determined from critical properties and experimental liquid enthalpies at the boiling point and at the critical point. The results of the proposed method are compared with those predicted with the modified Redlich-Kwong equation of state by Joffe and Zudkevitch.

### Acknowledgement

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## Introduction

The enthalpy of a saturated liquid at any given temperature can be obtained from the enthalpy departure evaluated analytically using an equation of state such as the Redlich-Kwong equation with the two coefficients,  $a$  and  $b$ , treated as temperature-dependent variables (1).

The method applied in this study has its origin in the modified Van der Waals equation developed by S. W. Benson and E. Gerjuoy in 1950 (2) :

$$P = RT/(V - bV^{-s}T^{-n}) - a/(V^mT^p) \quad (1)$$

The various exponents in the equation were evaluated by Benson and R.

A. Golding (3) based on the following criteria:

(a) Trouton's rule:  $E_{\text{vap}}/RT = 9.5$  ( at the boiling point )

(b) Critical ratio:  $1/Z_c = RT_c/P_cV_c = 3.70$

(c) Liquid density rule:  $1/\phi_b = 2.72$  ( at the boiling point )

(d) The coefficients of thermal expansion and compressibility at normal boiling points are about  $1.3 \times 10^{-3}/^\circ\text{K}$  and  $1.5 \times 10^{-4}/\text{atmos.}$  respectively.

The equation with the best choice of exponents becomes:

$$P = RT/(V - bV^{-1/2}) - a/(V^{5/3}T^{2/3}) \quad (2)$$

where  $a = 0.9099 RT_c^{5/3} V_c^{2/3}$  (2a)

$b = 0.1567 V_c^{3/2}$  (2b)

and in reduced form:

$$P/P_c = \pi = 3.624 \left( \theta / ( \phi - 0.1567 \phi^{-1/2} ) - 0.9099 / ( \phi^{5/3} \theta^{2/3} ) \right) \quad (3)$$

where  $\phi = V/V_c$ ;  $\theta = T/T_c$ .

It is shown by Benson and Golding (3) that this equation in predicting some physical properties such as liquid densities of non-associated substances, heats of vaporization and gas isotherms gives better results than the Van der Waals and Berthelot equations.

In the current study Equation 2 was applied to the calculation of liquid enthalpy departures of non-polar substances and mixtures. The systems studied were methane, propane, nitrogen, carbon dioxide and methane-propane mixtures. Satisfactory results were obtained with some modifications of the equation. A polar compound, ammonia, was also investigated.

Pure Substances

Liquid enthalpy departure can be calculated using the following thermodynamic relations:

$$(H^* - H)_T = RT - PV + \int_{\infty}^V (P - T(\partial P/\partial T)_V) dV \quad (4)$$

Differentiating Equation 2,

$$(\partial P/\partial T)_V = R/(V - bV^{-1/2}) + 2a/(3V^{5/3}T^{2/3}) \quad (5)$$

Multiplying both sides by T,

$$T(\partial P/\partial T)_V = RT/(V - bV^{-1/2}) + 2a/(3V^{5/3}T^{2/3}) \quad (6)$$

Substituting Equations 2 and 6 into Equation 4:

$$\begin{aligned} (H^* - H)_T &= RT - PV + \int_{\infty}^V \left( RT/(V - bV^{-1/2}) - a/(V^{5/3}T^{2/3}) \right. \\ &\quad \left. - RT/(V - bV^{-1/2}) - 2a/(3V^{5/3}T^{2/3}) \right) dV \\ &= RT - PV - \int_{\infty}^V \left( 5a/(3V^{5/3}T^{2/3}) \right) dV \\ (H^* - H)_T &= RT - PV + 5a/(2V^{2/3}T^{2/3}) \end{aligned} \quad (7)$$

where P and T are given, V is calculated from Equation 2 with the constants a and b evaluated from Equations 2a and 2b. Results obtained from Equation 7 for saturated liquid methane, propane, nitrogen and carbon dioxide were compared in the current study with the experimental values (4) and were found to be of low accuracy.

One of the original criteria used by Benson and Golding, the critical ratio,  $1/Z_C$ , has a generalized value of 3.70, or  $Z_C = 0.270$ . Since the

critical compressibility factors of most compounds are different from 0.270 (5), one of the exponents was changed in the current study to fit the experimental critical compressibility factor. The modified equation

$$P = RT/(V - bV^{-1/2}) - a/(V^n T^{2/3}) \quad (8)$$

where  $a = C_1 RT_C^{5/3} V_C^{n-1}$  and  $b = C_2 V_C^{3/2}$ , was made to satisfy the following conditions:

$$P_C = RT_C/(V_C - bV_C^{-1/2}) - a/V_C^n T_C^{2/3} = Z_C RT_C/V_C \quad (9)$$

$$\begin{aligned} (\partial P/\partial V)_{C.P.} &= (-RT_C)(1 + \frac{1}{2} bV_C^{-3/2})/(V_C - bV_C^{-1/2})^2 \\ &+ anV_C^{-n-1} T_C^{-2/3} = 0 \end{aligned} \quad (10)$$

$$\begin{aligned} (\partial^2 P/\partial V^2)_{C.P.} &= 3RT_C bV_C^{-5/2} / [4(V_C - bV_C^{-1/2})^2] + \\ &2RT_C(1 + \frac{1}{2} bV_C^{-3/2})^2 / (V_C - bV_C^{-1/2})^3 \\ &- an(n+1)V_C^{-n-2} T_C^{-2/3} = 0 \end{aligned} \quad (11)$$

By substituting a and b as defined for Equation 8 into Equations 9, 10, and 11, the constants  $C_1$ ,  $C_2$  and n can be calculated. The results are listed in Table 1.

Table 1

Constants Used in Equation 8

	Z	C	C	n
CH <sub>4</sub>	0.290	0.910	0.1667	1.715
C <sub>3</sub> H <sub>8</sub>	0.277	0.910	0.1575	1.670
N <sub>2</sub>	0.291	0.909	0.1670	1.716
CO <sub>2</sub>	0.2745	0.910	0.1558	1.662

The enthalpy departure can be calculated with the following equation:

$$(H^* - H)_T = RT - PV + 5a / \left( 3(n-1) V^{n-1} T^{3/2} \right) \quad (12)$$

The above change did not show any substantial improvement in accuracy over Equation 7.

Another trial was carried out by changing another exponent:

$$P = RT / (V - bV^{-m}) - a / (V^{5/3} T^{3/2}) \quad (13)$$

where  $a = C_3 RT_C^{5/3} V_C^{2/3}$  and  $b = C_4 V_C^{m+1}$

Again, the three conditions at the critical point used before were applied and  $C_3$ ,  $C_4$  and  $m$  were evaluated. This attempt was likewise unsuccessful, since the change of the exponent of the volume in the first term of the equation has almost no effect on the enthalpy departure.

From the previously calculated results, it was apparent that the deviation from the experimental value becomes larger as the temperature comes closer to the boiling point. Therefore, two exponents were changed to fit the vapor pressure and liquid density data at the boiling point in addition to the three conditions at the critical point:

$$P = RT / (V - bV^{-1/2}) - a / (V^n T^m) \quad (14)$$

where  $a = C_5 RT_C^{m-1} V_C^{n-1}$  and  $b = C_6 V_C^{3/2}$ ; and the enthalpy departure becomes:

$$(H^* - H)_T = RT - PV + (m+1)a / ((n-1) T^m V^{n-1}) \quad (15)$$

This modification did not improve the results significantly. However, from the previous attempts, it was found that the temperature exponent has a greater effect on enthalpy departure than the volume exponent, and that the temperature-enthalpy profile is of an inverse exponential type. Since  $e^{-x} = 1 - x/1! + x^2/2! - x^3/3! + \dots$ , the exponential can be approximated by omitting the terms after the second one. In order to compensate for the terms omitted, an exponent was added to the second term and a modified temperature function,  $(a - dT^m)$ , was tried:

$$P = RT/(V - bV^{-1/2}) - (a - dT^m)/V^n \quad (16)$$

$$\text{where } a = C_7 RT_c V_c^{n-1} \quad (16a)$$

$$b = C_8 V_c^{3/4} \quad (16b)$$

$$d = C_9 RT_c^{1-m} V_c^{n-1} \quad (16c)$$

Applying the three conditions of Equations 9, 10 and 11, there is obtained for the enthalpy departure:

$$(H^* - H)_T = RT - PV + \left[ a + (m - 1)dT^m \right] / \left[ (n - 1)V^{n-1} \right] \quad (17)$$

The three conditions at the critical point and the experimental liquid enthalpies at the boiling point and at the critical point were used to determine  $C_7$ ,  $C_8$ ,  $C_9$ ,  $n$  and  $m$  for each of the pure substances studied. The polar substance, ammonia, was added to those previously studied. The values are given in Table 2.

To find the enthalpy departure with Equation 17, the following procedure is used: the temperature and vapor pressure of the pure substance are substituted into Equation 16 and the latter is solved for

the liquid volume. The calculated liquid volume is substituted into Equation 17 to obtain the enthalpy departure.

The calculated enthalpy departures are compared with the experimental values as shown in Tables 3-7.

Table 2

Constants Used in Equation 16

	C7	C8	C9	n	m
CH <sub>4</sub>	2.250	0.1667	1.340	1.715	0.385
C <sub>3</sub> H <sub>8</sub>	3.680	0.1575	2.770	1.670	0.250
N <sub>2</sub>	2.340	0.1670	1.431	1.716	0.385
CO <sub>2</sub>	3.580	0.1558	2.670	1.662	0.300
NH <sub>3</sub>	3.490	0.1342	2.577	1.559	0.270

### Binary Mixtures

The methane-propane system of three different compositions, 76.6, 5.2 and 12 mole per cent propane-in-methane mixtures, were studied using the proposed method.

The enthalpy departure of each component was calculated at a reduced temperature which is the same as the pseudoreduced temperature of the mixture. The latter is defined as the temperature of the mixture divided by the pseudocritical temperature. The pseudocritical temperature can be established by applying a mixing rule. Two mixing rules were used: Kay's rule (6) and the correlation developed by Yesavage and Powers (7).

The enthalpy departure of the mixture was found as the summation of the enthalpy departures of each component calculated as explained above and multiplied by its mole fraction in the mixture. This procedure for finding a residual property of a mixture has been discussed elsewhere by Joffe (11).

The results are presented in Table 8 along with the experimental values (8,9,10) and the calculations of Joffe and Zudkevitch who used the modified Redlich-Kwong Equation of State with temperature-dependent coefficients (1).



## Discussion of Results

The proposed method with the temperature-independent coefficients derived from the Equation of State of Benson and Golding predicts the liquid enthalpy departures in close agreement with the experimental values for the four non-polar, pure substances tested. The maximum absolute deviation is 3.3 Btu/lb ( Tables 3 to 6 ). It also works reasonably well for the non-polar mixtures tested in this study, provided that the proper mixing rule is applied ( Table 8 ). The average deviation of the calculated values is of the same order of magnitude as for the method of Joffe and Zudkevitch.

For the polar substance, liquid ammonia, the calculated enthalpy departure and the experimental value are fairly close at temperatures near the boiling point and the critical point ( Table 7 ). For the temperature range from 280°K to 380°K, the average absolute deviation is approximately 14.9 Btu/lb and the maximum deviation is about 20.6 Btu/lb. This is probably the result of the difference in the temperature-enthalpy profiles for non-polar and polar substances. One possible correction for this deviation is to add another temperature term to the existing (  $a - dT^m$  ) function presently employed. Another possible solution is to make the exponent  $m$ , a temperature-dependent one. This will make the enthalpy departure expression very complicated.

Table 3

## Enthalpy Departures of Saturated Liquid Methane

Temperature in °K	Pressure in Atm	$H^* - H$ , Btu/lb	
		Experimental	Calculated
120 ✓	1.905	217.5	214.5
125	2.669	214.3	211.8
130	3.641	211.0	209.0
135	4.855	207.5	206.0
140 ✓	6.339	203.9	202.8
145	8.132	200.0	199.3
150	10.27	196.0	195.6
155	12.79	191.6	191.6
160 ✓	15.74	186.9	187.1
165	19.14	181.8	182.1
170	23.00	176.0	176.3
175	27.49	169.5	169.6
Average absolute deviation			1.0

Table 4

## Enthalpy Departures of Saturated Liquid Propane

Temperature in °K	Pressure in Atm	$H^* - H$ , Btu/lb	
		Experimental	Calculated
248.06	2	179.5	178.2
259.33	3	175.2	174.7
268.05	4	171.7	171.8
275.24	5	169.4	169.4
281.44	6	167.1	167.2
286.90	7	165.1	165.2
291.83	8	163.2	163.4
296.30	9	161.4	161.6
300.44	10	159.6	160.0
317.42	15	152.1	152.4
330.70	20	144.5	145.3
341.71	25	137.3	138.3
Average absolute deviation			0.4

Table 5

## Enthalpy Departures of Saturated Liquid Nitrogen

Temperature in °K	Pressure in Atm	$H^* - H$ , Btu/lb	
		Experimental	Calculated
71.91	0.5	88.1	85.3
74.45	0.7	87.8	84.5
77.35	1	86.5	83.6
83.80	2	83.9	81.6
88.04	3	82.3	80.1
94.09	5	79.7	77.8
98.60	7	77.8	75.8
103.88	10	75.2	73.2
110.57	15	70.5	69.2
115.80	20	65.9	65.2
120.13	25	60.8	60.7
123.86	30	54.8	54.8
Average absolute deviation			1.8

Table 6

## Enthalpy Departures of Saturated Liquid Carbon Dioxide

Temperature in °C	Pressure in Atm	$H^* - H$ , Btu/lb	
		Experimental	Calculated
-30	14.103	143.2	143.0
-25	16.618	140.7	140.8
-20	19.449	138.3	138.5
-15	22.617	135.4	136.1
-10	26.147	134.2	133.5
-5	30.165	129.3	130.6
0	34.397	126.0	127.6
5	39.172	122.7	124.2
10	44.425	118.6	120.3
15	50.192	113.9	115.9
20	56.525	109.4	110.6
25	63.487	102.7	103.6
Average absolute deviation			1.0

Table 7

## Enthalpy Departures of Saturated Liquid Ammonia

Temperature in °K	Pressure in Atm	$H^* - H, \text{ Btu/lb}$	
		Experimental	Calculated
230	0.5982	600.8	597.0
240	1.0124	590.4	589.1
260	2.526	570.8	573.3
280	5.446	549.4	556.7
300	10.485	528.7	538.9
310	14.063	516.7	529.1
320	18.49	504.2	519.4
330	23.90	491.6	508.8
340	30.42	478.2	497.3
360	47.40	449.8	470.4
380	70.60	417.9	434.9
400	101.5	369.7	375.0
Average absolute deviation			11.0

Table 8

Enthalpy Departures of Methane-Propane Saturated Liquid Mixtures

Mole Fraction Propane	Temperature °F	Pressure psia	$H^* - H$ , Btu/lb				
			Experimental	Calculated			Joffe and Zudkevitch 1970
				Kay's Rule 1936	Yesavage & Powers 1969	C <sub>ij</sub> = 0	
0.766 (8)	-144	100	204.5	196.2	197.2	203.2	199.7
	-100	200	193.5	188.2	189.4	194.0	190.7
	-62	300	184.3	181.2	182.5	184.8	181.6
	-24	400	175.6	173.5	175.2	174.4	171.3
	12	500	166.7	165.3	167.4	165.2	161.6
	47	600	158.0	155.4	158.2	154.8	151.6
	76	700	149.5	140.8	145.0	146.5	142.3
	102	800	140.4	132.5	138.0	138.2	134.0
0.052 (9)	-260	10	221.5	217.6	218.0	226.4	222.5
	-200	102	198.6	200.2	200.9	203.5	199.7
	-120	580	157.8	157.0	160.6	170.5	163.0
0.12 (10)	-209	100	210.6	202.9	204.5	211.3	204.7
	-150	300	188.1	183.3	186.0	186.8	180.3
	-124	500	170.9	170.3	174.8	171.8	173.0
	-101	700	159.4	154.7	161.3	161.6	153.3
Average absolute deviation				4.2	2.9	2.7	4.6

### Conclusions

For non-polar substances and mixtures, the proposed method gives a quick and fairly accurate estimate of enthalpy departure in the saturated liquid phase up to the critical point.

For polar substances, a better approach is required. This can possibly be done by modifying the temperature function in the second term of the equation.

In general, this empirical equation is simple to use. The coefficients are easily determined from critical properties and experimental enthalpies at the boiling point and the critical point. Even though the procedure is a trial-and-error one, it only takes a few trials to obtain the optimum value of the exponents for each substance.



Nomenclature

$a, b, d$  = coefficients in Benson-Golding and the modified equations

$C_1, C_2, \dots, C_9$  = constants for evaluating coefficients  $a, b, d$

$E_{\text{vap}}$  = heat of vaporization

$H^*$  = ideal gas state enthalpy above datum

$H$  = enthalpy of saturated liquid

$m, n$  = exponents in the modified equation of state

$P$  = pressure

$P_c$  = critical pressure

$R$  = gas constant

$T$  = temperature

$T_c$  = critical temperature

$V$  = volume

$V_c$  = critical volume

$Z_c$  = critical compressibility factor

$\theta$  = reduced temperature

$\pi$  = reduced pressure

$\phi$  = reduced volume

$\phi_b$  = reduced volume at the boiling point

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A P P E N D I X

## Critical Constants of Pure-Components

	$P_c$	$T_c$	$V_c$	$Z_c$
	Atm	$^{\circ}K$	$cm^3/g\text{-mole}$	
CH <sub>4</sub>	45.8	191.06	98.72	0.29
C <sub>3</sub> H <sub>8</sub>	42.1	370.0	200	0.277
N <sub>2</sub>	33.5	126.2	90.094	0.291
CO <sub>2</sub>	72.85	304.2	94.04	0.274
NH <sub>3</sub>	112.5	405.6	72.5	0.242

Source: Reid, R. C. and T. K. Sherwood, "The Properties of Gases and Liquids", 2nd. Ed., 571, 572, 580, 583 (1966)

## Pseudocritical Temperatures of Methane-Propane Mixtures

Mole Fraction of Propane in the Mixture	Temperatures in $^{\circ}R$	
	Kay's Rule	Yesavage & Powers ( Smoothed Optimum Values )
0.766	590.6	601.5
0.052	360.7	364.3
0.12	382.6	391.5

\*JOB SUSAN CHIEF

```

030438 C NETHANE
030438 READ,TN
030444 READ,BK,ZC,AN
030458 READ,TC,PC,VC,R
030470 N=1
030478 1 READ,T,P,V
03048C TM=1.0-TN
030498 AP=(1.7/(1.-BK))-ZC
0304AE CK=2.25
0304B6 Q=TC**TM
0304CC S=VC**AN
0304E4 T1=T**TM
0304FC D=CK*TC-(CK-AP)*Q*T1
03051A A=R*S*D
03052A U=VC**1.5
030540 B=BK*U
03054C D2=CK*TC-TM*(CK-AK)*Q*T1
03056E V=.8*V
03057A BN=AN+1.0
030586 4 C=V**(-BN)
0305A8 E=V**.5
0305C0 F=V**(-AN)
0305F0 G=V-B/E
0305F2 IF(G)6,6,7
030600 6 V=1.01*(B**0.6667)
03061C GO TO 4
030620 7 P1=(K*T/G)-A*C
03063A PRINT,V,P1
03064C IF(ABS(P1-P)-0.005)2,2,5
030674 5 H=V**(-1.5)
030694 W=V**(-RN-1.0)
0306B8 W1=R*T*(1.+R**0/2.)/(G**2.)
0306FA PV=RN*A*W-w1
0306FE DP=P-P1
03070A DV=(DP/PV)/2.
03071A V1=V+DV
030726 IF(V1-V)2,2,8
030736 8 V=V1
03073E GO TO 4
030742 2 DH=R*T-P1*V+K*S*D2*F/AN
03076E CH=DH*1.987/82.05
03077E BH=CH*1.8
03078A PRINT,DH,CH,BH
0307A0 PRINT,I,P,V
0307B4 N=N+1
0307C0 IF(N-12)1,1,3
0307D0 3 STOP
0307D4 END

```

\*RUN

8  
9  
6  
01  
11  
21

+.3116796F+02	+.3941366F+04	
+.3165757F+02	+.2529725F+04	
+.3227064F+02	+.1602546F+04	
+.3290444F+02	+.9989721F+03	
+.3379071F+02	+.6107790F+03	
+.3450683F+02	+.3649780F+03	
+.3533796F+02	+.2124101F+03	
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9	+ .535182E+02	+ .275000E+02	
2	+ .535194E+02	+ .274953E+02	
8	+ .535201E+02	+ .274926E+02	
6	+ .622516E+03	+ .150754E+04	+ .271357E+04
01	+ .175000E+03	+ .274899E+02	+ .535201E+02
11			
21			

END OF JOB

\*JUP SUSAN CHIEF

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030438 C PPROPANE
030438 READ,TN
030444 READ,BK,ZC,AN
030458 READ,TC,PC,VC,R
030470 N=1
030478 1 READ,T,P,V
03048C TN=1.0-TN
030498 AK=(1./(1.-BK))=ZC
0304AE CK=3.68
0304B6 Q=TC**TM
0304CC S=VC**AN
0304F4 T1=T**TN
0304FC D=CK*TC-(CK-AK)*Q*T1
03051A A=R*S*D
03052A U=VC**1.5
030540 B=BK**H
03054C D2=CK*TC-TN*(CK-AK)*Q*T1
03056E V=.8*V
03057A BH=AN+1.0
030586 4 C=V**(-BN)
0305A8 E=V**.5
0305C0 F=V**(-AN)
0305F0 G=V-B/E
0305F2 IF(G)6,6,7
030600 6 V=1.01*(B**0.6667)
03061C GO TU 4
030620 7 PI=(R*T/G)-A*C
03063A PPINT,V,PI
03064C IF(ABS(PI-P)-0.005)2,2,5
030674 5 H=V**(-1.5)
030694 W=V**(-BN-1.0)
0306B8 W1=R*T*(1.+B**H/2.)/(G**2.)
0306EA PV=BN*A*W-w1
0306FE DP=P-PI
03070A DV=(DP/PV)/2.
03071A V1=V+DV
030726 IF(V1-V)2,2,6
030736 6 V=V1
03073E GO TU 4
030742 2 DH=R*T-PI*V+R*S*D2*F/AN
03076E CH=DH*1.97/82.05
03077E BH=CH*1.8
03078A PRINT,DH,CH,BH
0307A0 PRINT,T,P,V
0307B4 N=N+1
0307C0 IF(N-12)1,1,3
0307D0 3 STOP
0307D4 END

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\*RJN

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+ .6271998E+02	+ .1910503E+04	
+ .6414137E+02	+ .1199491E+04	
+ .6575456E+02	+ .7398859E+03	
+ .6745021E+02	+ .4468857E+03	
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	+ .2752399F+03	+ .5000000E+01	+ .7820394E+02
	+ .6791998E+02	+ .6579987F+03	
	+ .7010769F+02	+ .4027524F+03	
	+ .7247470E+02	+ .2423051E+03	
	+ .7456215E+02	+ .1432080E+03	
	+ .7620498F+02	+ .8337329F+02	
	+ .775F459F+02	+ .4820345F+02	
	+ .7844392F+02	+ .2845751F+02	
	+ .789F296F+02	+ .1765039F+02	
	+ .7925373E+02	+ .1194775F+02	
	+ .7940860E+02	+ .9007324F+01	
	+ .7949878E+02	+ .7513183F+01	
	+ .7952957E+02	+ .6758544F+01	
	+ .7955014E+02	+ .6370638F+01	
	+ .7956045F+02	+ .6180941F+01	
	+ .7956562F+02	+ .6096191F+01	
	+ .7956825F+02	+ .6048339F+01	
	+ .7956954F+02	+ .6023681F+01	
	+ .7957019E+02	+ .6013427F+01	
	+ .7957055E+02	+ .6005859F+01	
	+ .7957070E+02	+ .6002441F+01	
	+ .1687958E+06	+ .4087712E+04	+ .7357870E+04
	+ .2814399F+03	+ .6000000F+01	+ .7957070E+02
	+ .6895999F+02	+ .5661037F+03	
	+ .7137237F+02	+ .3459956F+03	
	+ .7374935F+02	+ .2001462F+03	
	+ .7580666F+02	+ .1233300F+03	
	+ .7765284F+02	+ .7233544F+02	
	+ .7894091F+02	+ .4257788F+02	
	+ .7978804F+02	+ .2583056F+02	
	+ .8029438F+02	+ .1674731F+02	
	+ .8057603F+02	+ .1196972F+02	
	+ .8072544F+02	+ .9510253F+01	
	+ .8082252F+02	+ .8262207F+01	
	+ .8084160E+02	+ .7632324F+01	

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+ .8065141E+02	+ .7317382F+01	
+ .8067135E+02	+ .7159179F+01	
+ .8067632E+02	+ .7079833F+01	
+ .8067882E+02	+ .7039550F+01	
+ .8068006E+02	+ .7019775F+01	
+ .8068067E+02	+ .7010009F+01	
+ .8068096E+02	+ .7005371F+01	
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+ .8216264E+02	+ .8005126E+01	
+ .8216282E+02	+ .8002197E+01	
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+ .8337806E+02	+ .9465576E+01	
+ .8339680E+02	+ .9233154E+01	
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+ .7469087E+02	+ .2394523E+03	
+ .7731861E+02	+ .1450737E+03	
+ .7962015E+02	+ .8749316E+02	
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+ .8458946E+02	+ .1061591E+02	
+ .8462651E+02	+ .1040942E+02	
+ .8464518E+02	+ .1020507E+02	

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+ .8465455F+02	+ .1010253F+02	
+ .8465924F+02	+ .1005151F+02	
+ .8466159F+02	+ .1002539F+02	
+ .8466275F+02	+ .1001245F+02	
+ .8466331F+02	+ .1000659F+02	
+ .8466360F+02	+ .1000415F+02	
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+ .7989904F+02	+ .1538312F+03	
+ .8297835F+02	+ .9619139F+02	
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+ .8757946E+02	+ .4065405F+02	
+ .8893582E+02	+ .2880444F+02	
+ .8987421E+02	+ .2223876E+02	
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+ .9054029E+02	+ .9127099E+02	
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+ .9795868E+02	+ .4727270E+02	
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+ .1047322E+03	+ .2685180E+02	
+ .1051601E+03	+ .2594433E+02	
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+ .1055640E+03	+ .2512050E+02	
+ .1055942E+03	+ .2506005E+02	
+ .1056092E+03	+ .2503002E+02	
+ .1056167E+03	+ .2501489E+02	
+ .1056205E+03	+ .2500756E+02	
+ .1056224E+03	+ .2500415E+02	
+ .1056224E+03	+ .2500395E+02	
		+ .6085602E+04



+ .3417099E+03

+ .2500000E+02

+ .1056224E+03

END OF JOB

\*JLB SUSAN CHIEF

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030438 C NITROGEN
030438 READ,TN
030444 READ,BK,ZC,AN
030448 READ,TC,PC,VC,R
030470 N=1
030478 1 READ,T,P,V
030480 TM=1.0-TN
030498 AK=(1./(1.-BK))-ZC
0304AE CK=2.34
0304B6 Q=TC**TM
0304C0 S=VC**AN
0304E4 T1=T**TM
0304FC D=CK*TC-(CK-AK)*Q*T1
03051A A=R*S*D
03052A U=VC**1.5
030540 B=BK*U
03054C D2=CK*TC-TM*(CK-AK)*Q*T1
03056E V=.8*V
03057A BN=AN+1.0
030586 4 C=V**(-BN)
0305A8 E=V**.5
0305C0 F=V**(-AN)
0305E0 G=V-B/E
0305F2 IF(C)6,6,7
030600 6 V=1.01*(B**0.6667)
03061C GO TO 4
030620 7 P1=(R*T/G)-A*C
03063A PRINT,V,P1
03064C IF(ABS(P1-P)-0.005)2,2,5
030674 5 H=V**(-1.5)
030694 W=V**(-BN-1.0)
0306B8 W1=R*T*(1.+B**W/2.)/(G**2.)
0306FA PV=BN*A*W-W1
0306FE DP=P-P1
03070A DV=(DP/PV)/2.
03071A V1=V+DV
030726 IF(V1-V)2,2,8
030736 8 V=V1
03073E GO TO 4
030742 2 DH=R*T-P1*V+R*S*D2*F/AN
03076E CH=DH*1.987/82.05
03077E BH=CH*1.8
03078A PRINT,DH,CH,BH
0307A0 PRINT,T,P,V
0307B4 N=N+1
0307C0 IF(N-12)1,1,3
0307D0 3 STOP
0307D4 END

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\*RUN

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+ .2759933E+02	+ .1315955E+05	
+ .2772850E+02	+ .8671570E+04	
+ .2791145E+02	+ .5684378E+04	
+ .2816419E+02	+ .3699501E+04	
+ .2850167E+02	+ .2384480E+04	
+ .2893258E+02	+ .1517573E+04	
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+ .3770382E+02	+ .7105541E+02	
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+ .4033807E+02	+ .1526220E+02	
+ .4051907E+02	+ .1269311E+02	
+ .4061625E+02	+ .1136401E+02	
+ .4066674E+02	+ .1068627E+02	
+ .4069240E+02	+ .1034497E+02	
+ .4070555E+02	+ .1017260E+02	

+ .4071205E+02	+ .1008691E+02	
+ .4071534E+02	+ .1004345E+02	
+ .4071699E+02	+ .1002172E+02	
+ .4071781E+02	+ .1001025E+02	
+ .4071820E+02	+ .1000561E+02	
+ .4071839E+02	+ .1000292E+02	
+ .4702840E+05	+ .1138885E+04	+ .2049993E+04
+ .1038799E+03	+ .1000000E+02	+ .4071839E+02
+ .3631999E+02	+ .1829807E+03	
+ .3799324E+02	+ .1161230E+03	
+ .3959968E+02	+ .7479541E+02	
+ .4103520E+02	+ .4959936E+02	
+ .4221400E+02	+ .3450927E+02	
+ .4309239E+02	+ .2569018E+02	
+ .4368312E+02	+ .2069590E+02	
+ .4404409E+02	+ .1796313E+02	
+ .4424827E+02	+ .1651611E+02	
+ .4435780E+02	+ .1576757E+02	
+ .4441467E+02	+ .1538696E+02	
+ .4444372E+02	+ .1519409E+02	
+ .4445838E+02	+ .1509716E+02	
+ .4446575E+02	+ .1504882E+02	
+ .4446946E+02	+ .1502441E+02	
+ .4447131E+02	+ .1501171E+02	
+ .4447219E+02	+ .1500659E+02	
+ .4447260E+02	+ .1500366E+02	
+ .4446028E+05	+ .1076691E+04	+ .1938043E+04
+ .1105699E+03	+ .1500000E+02	+ .4447260E+02
+ .3911190E+02	+ .1237067E+03	
+ .4109495E+02	+ .8232128E+02	
+ .4298617E+02	+ .5686523E+02	
+ .4469473E+02	+ .4138842E+02	
+ .4609371E+02	+ .3211962E+02	
+ .4716369E+02	+ .2668432E+02	
+ .4790010E+02	+ .2358496E+02	
+ .4836041E+02	+ .2187573E+02	
+ .4862551E+02	+ .2096337E+02	
+ .4876945E+02	+ .2048901E+02	
+ .4884475E+02	+ .2024633E+02	
+ .4888320E+02	+ .2012353E+02	
+ .4890277E+02	+ .2006201E+02	
+ .4891250E+02	+ .2003100E+02	
+ .4891749E+02	+ .2001580E+02	
+ .4892001E+02	+ .2000781E+02	
+ .4892124E+02	+ .2000390E+02	
+ .4186290E+05	+ .1013791E+04	+ .1824823E+04
+ .1157999E+03	+ .2000000E+02	+ .4892124E+02
+ .4260790E+02	+ .8649096E+02	
+ .4494425E+02	+ .6196557E+02	
+ .4719154E+02	+ .4693481E+02	
+ .4921492E+02	+ .3780957E+02	
+ .5094935E+02	+ .3233276E+02	
+ .5231910E+02	+ .2909790E+02	
+ .5330833E+02	+ .2722949E+02	
+ .5395760E+02	+ .2618115E+02	
+ .5434754E+02	+ .2561303E+02	
+ .5456585E+02	+ .2531257E+02	
+ .5468205E+02	+ .2515820E+02	
+ .5474221E+02	+ .2507955E+02	
+ .5477282E+02	+ .2503979E+02	
+ .5478822E+02	+ .2502012E+02	
+ .5479603E+02	+ .2500976E+02	
+ .5479981E+02	+ .2500521E+02	
+ .5480184E+02	+ .2500234E+02	
+ .3897402E+05	+ .9438308E+03	+ .1698894E+04
+ .1201290E+02	+ .2500000E+02	+ .5480184E+02

+ .4778396E+02	+ .6081713E+02	
+ .5057135E+02	+ .4856469E+02	
+ .5326922E+02	+ .4108447E+02	
+ .5578822E+02	+ .3654762E+02	
+ .5804164E+02	+ .3381692E+02	
+ .5995446E+02	+ .3218829E+02	
+ .6147619E+02	+ .3122857E+02	
+ .6259532E+02	+ .3067329E+02	
+ .6334907E+02	+ .3035945E+02	
+ .6381355E+02	+ .3018766E+02	
+ .6407916E+02	+ .3009636E+02	
+ .6422294E+02	+ .3004873E+02	
+ .6429777E+02	+ .3002468E+02	
+ .6433625E+02	+ .3001213E+02	
+ .6435530E+02	+ .3000627E+02	
+ .6436516E+02	+ .3000312E+02	
+ .3521444E+05	+ .8527856E+03	+ .1535015E+04
+ .1238599E+03	+ .3000000E+02	+ .6436516E+02

END OF JOB

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          *JL9 SUSAN CHIEN
030438      C      CARBON DIOXIDE
030438      READ,TN
030444      READ,BK,ZC,AN
030458      READ,TC,PC,VC,R
030470      N=1
030478      1      READ,T,P,V
03048C      TM=1.0-TN
030498      AK=(1.7/(1.-BK))-ZC
0304AE      CK=3.58
0304B6      Q=TC**TM
0304CC      S=VC**AN
0304E4      T1=T**TN
0304FC      D=CK*TC-(CK-AK)*Q*T1
03051A      A=R*S*D
03052A      U=VC**1.5
030540      B=BK*U
03054C      D2=CK*TC-TM*(CK-AK)*Q*T1
03056E      V=.8*V
03057A      BN=AN+1.0
030586      4      C=V**(-BN)
0305A8      E=V**.5
0305C0      F=V**(-AN)
0305F0      G=V-b/E
0305F2      IF(G)6,6,7
030600      6      V=1.01*(B**0.6667)
03061C      GO TO 4
030620      7      P1=(R*T/G)-A*C
03063A      PRINT,V,P1
03064C      IF(ABS(P1-P)-0.005)2,2,5
030674      5      H=V**(-1.5)
030694      W=V**(-BN-1.0)
0306B8      W1=R*T*(1.+B**H/2.)/(G**2.)
0306FA      PV=BN*A*W-w1
0306FE      DP=P-P1
03070A      DV=(DP/PV)/2.
03071A      V1=V+DV
030726      IF(V1-V)2,2,8
030736      8      V=V1
03073E      GO TO 4
030742      2      DH=R*T-P1*V+R*S*D2*F/AN
03076E      CH=DH*1.977/82.05
03077E      BH=CH*1.8
03078A      PRINT,DH,CH,BH
0307A0      PRINT,T,P,V
0307B4      N=N+1
0307C0      IF(N-12)1,1,3
0307D0      3      STOP
0307D4      END
          *RUN

```



+ .3276799E+02	+ .8517805E+03	
+ .3395997E+02	+ .5199417E+03	
+ .3511462E+02	+ .3129154E+03	
+ .3613926E+02	+ .1960063E+03	
+ .3696183E+02	+ .1101516E+03	
+ .3755407E+02	+ .6615195E+02	
+ .3793713E+02	+ .4154199E+02	
+ .3816311E+02	+ .2826293E+02	
+ .3828765E+02	+ .2131152E+02	
+ .3835339E+02	+ .1773950E+02	
+ .3838719E+02	+ .1593164E+02	
+ .3840434E+02	+ .1502026E+02	
+ .3841297E+02	+ .1456176E+02	
+ .3841731E+02	+ .1433276E+02	
+ .3841947E+02	+ .1421997E+02	
+ .3842057E+02	+ .1416162E+02	
+ .3842112E+02	+ .1413232E+02	
+ .3842140E+02	+ .1411791E+02	
+ .3842153E+02	+ .1411083E+02	
+ .3842160E+02	+ .1410693E+02	
+ .1443673E+06	+ .3496133E+04	+ .6293035E+04
+ .2431599E+03	+ .1410299E+02	+ .3842160E+02
+ .3343998E+02	+ .7145598E+03	
+ .3470764E+02	+ .4364455E+03	
+ .3591790E+02	+ .2636567E+03	
+ .3697660E+02	+ .1582426E+03	
+ .3781459E+02	+ .9545263E+02	
+ .3840992E+02	+ .5919189E+02	
+ .3879055E+02	+ .3900122E+02	
+ .3901313E+02	+ .2814892E+02	
+ .3913510E+02	+ .2247924E+02	
+ .3919921E+02	+ .1957714E+02	
+ .3923216E+02	+ .1810327E+02	
+ .3924884E+02	+ .1736303E+02	
+ .3925724E+02	+ .1690096E+02	
+ .3926145E+02	+ .1680688E+02	
+ .3926359E+02	+ .1671118E+02	
+ .3926464E+02	+ .1666528E+02	
+ .3926518E+02	+ .1664062E+02	
+ .3926542E+02	+ .1663208E+02	
+ .3926557E+02	+ .1662426E+02	
+ .3926564E+02	+ .1662109E+02	
+ .1421628E+06	+ .3442748E+04	+ .6196941E+04
+ .2481599E+03	+ .1661799E+02	+ .3926564E+02
+ .3417597E+02	+ .6008283E+03	
+ .3552291E+02	+ .3680378E+03	
+ .3679286E+02	+ .2239250E+03	
+ .3789054E+02	+ .1363056E+03	
+ .3874949E+02	+ .8430297E+02	
+ .3935334E+02	+ .5438159E+02	
+ .3973602E+02	+ .3777685E+02	
+ .3995832E+02	+ .2887817E+02	
+ .4007963E+02	+ .2423552E+02	
+ .4014324E+02	+ .2186279E+02	
+ .4017534E+02	+ .2066259E+02	
+ .4019236E+02	+ .2005810E+02	
+ .4020069E+02	+ .1975292E+02	
+ .4020486E+02	+ .1960253E+02	
+ .4020697E+02	+ .1952514E+02	
+ .4020806E+02	+ .1948754E+02	

	+ .402082F+02	+ .1946728F+02	
	+ .4020877F+02	+ .1946044F+02	
6	+ .4020892F+02	+ .1945410F+02	
7	+ .4020895F+02	+ .1945141F+02	
8	+ .1390356F+06	+ .3386392F+04	+ .0090500F+04
9	+ .2531599F+03	+ .1944898F+02	+ .4020898F+02
2	+ .3493399F+02	+ .5066584F+03	
8	+ .3641564E+02	+ .3120661F+03	
6	+ .3775160F+02	+ .1919780F+03	
01	+ .3889561E+02	+ .1191860F+03	
11	+ .3978335F+02	+ .7609790F+02	
21	+ .4040287F+02	+ .5137109F+02	
	+ .4079315E+02	+ .3768530F+02	
	+ .4101893F+02	+ .3036083F+02	
	+ .4114176F+02	+ .2654956F+02	
	+ .4120610E+02	+ .2459838F+02	
	+ .4123904F+02	+ .2361254F+02	
	+ .4125572F+02	+ .2311596F+02	
	+ .4126411E+02	+ .2286669F+02	
	+ .4126832E+02	+ .2274145F+02	
	+ .4127041E+02	+ .2267968F+02	
	+ .4127146E+02	+ .2264868F+02	
	+ .4127200E+02	+ .2263281F+02	
	+ .4127226F+02	+ .2262475F+02	
	+ .4127238F+02	+ .2262182F+02	
	+ .1373644F+06	+ .3326545F+04	+ .5987777F+04
	+ .2581599F+03	+ .2261698F+02	+ .4127238F+02
	+ .3584799F+02	+ .4322893E+03	
	+ .3737313F+02	+ .2685903F+03	
	+ .3878712F+02	+ .1678208F+03	
	+ .3999225F+02	+ .1088513F+03	
	+ .4092437E+02	+ .7081616F+02	
	+ .4157363E+02	+ .5015722E+02	
	+ .4198225E+02	+ .3872583E+02	
	+ .4221850E+02	+ .3261230F+02	
	+ .4234704E+02	+ .2942944F+02	
	+ .4241435E+02	+ .2780004F+02	
	+ .4244879F+02	+ .2697875F+02	
	+ .4246626F+02	+ .2656469F+02	
	+ .4247506E+02	+ .2635424F+02	
	+ .4247944F+02	+ .2625146F+02	
	+ .4248164F+02	+ .2619848F+02	
	+ .4248272F+02	+ .2617358F+02	
	+ .4248377E+02	+ .2616210E+02	
	+ .4248358E+02	+ .2615283F+02	
	+ .4248370E+02	+ .2615087F+02	
	+ .1347208E+06	+ .3262527E+04	+ .5872542E+04
	+ .2631599E+03	+ .2614698F+02	+ .4248370E+02
	+ .3679996E+02	+ .3708061F+03	
	+ .3843005F+02	+ .2332648F+03	
	+ .3993598F+02	+ .1487600F+03	
	+ .4121804F+02	+ .9769335F+02	
	+ .4221075F+02	+ .6752197F+02	
	+ .4290394F+02	+ .5021679F+02	
	+ .4334158E+02	+ .4063037E+02	
	+ .4359529F+02	+ .3550000F+02	
	+ .4373361F+02	+ .3282373F+02	
	+ .4380607E+02	+ .3145629F+02	
	+ .4384325E+02	+ .3076416F+02	
	+ .4386206E+02	+ .3041503E+02	
	+ .4387152E+02	+ .3024047E+02	
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	+ .4387866E+02	+ .3010864E+02	
	+ .4387983E+02	+ .3008671E+02	
	+ .4389043E+02	+ .3007690E+02	
	+ .4389075E+02	+ .3007055E+02	

	+ .438708E+02	+ .300688E+02	
	+ .1319687E+06	+ .3193457E+04	+ .5748216E+04
0	+ .2661599E+03	+ .3006498E+02	+ .4388085E+02
1	+ .3787199E+02	+ .3187270E+03	
5	+ .3962167E+02	+ .2038964E+03	
9	+ .4128672E+02	+ .1334531E+03	
2	+ .4261480E+02	+ .9090893E+02	
8	+ .4369736E+02	+ .6575781E+02	
6	+ .4444165E+02	+ .5130556E+02	
01	+ .4492137E+02	+ .4327978E+02	
11	+ .4520123E+02	+ .3897045E+02	
21	+ .4535440E+02	+ .3672143E+02	
	+ .4543489E+02	+ .3557006E+02	
	+ .4547622E+02	+ .3498657E+02	
	+ .4549719E+02	+ .3469189E+02	
	+ .4550772E+02	+ .3454516E+02	
	+ .4551301E+02	+ .3447094E+02	
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	+ .4551698E+02	+ .3441577E+02	
	+ .4551765E+02	+ .3440600E+02	
	+ .4551797E+02	+ .3440185E+02	
	+ .1287591E+06	+ .3119153E+04	+ .5612671E+04
	+ .2731599E+03	+ .3439698E+02	+ .4551797E+02
	+ .3917597E+02	+ .2695383E+03	
	+ .4106106E+02	+ .1764562E+03	
	+ .4279978E+02	+ .1194467E+03	
	+ .4428750E+02	+ .8504052E+02	
	+ .4545249E+02	+ .6468383E+02	
	+ .4627870E+02	+ .5296313E+02	
	+ .4680889E+02	+ .4643261E+02	
	+ .4712051E+02	+ .4291772E+02	
	+ .4729203E+02	+ .4107812E+02	
	+ .4738249E+02	+ .4013403E+02	
	+ .4742901E+02	+ .3965576E+02	
	+ .4745263E+02	+ .3941381E+02	
	+ .4746449E+02	+ .3929345E+02	
	+ .4747045E+02	+ .3923291E+02	
	+ .4747344E+02	+ .3920288E+02	
	+ .4747496E+02	+ .3918725E+02	
	+ .4747570E+02	+ .3918017E+02	
	+ .4747610E+02	+ .3917456E+02	
	+ .1253228E+06	+ .3034934E+04	+ .5462878E+04
	+ .2781599E+03	+ .3917199E+02	+ .4747610E+02
	+ .4077598E+02	+ .2250478E+03	
	+ .4281825E+02	+ .1520554E+03	
	+ .4470271E+02	+ .1074279E+03	
	+ .4632279E+02	+ .8050610E+02	
	+ .4760284E+02	+ .6455834E+02	
	+ .4852157E+02	+ .5534863E+02	
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	+ .4947370E+02	+ .4740893E+02	
	+ .4967060E+02	+ .4594555E+02	
	+ .4977494E+02	+ .4519409E+02	
	+ .4982882E+02	+ .4481127E+02	
	+ .4985617E+02	+ .4461791E+02	
	+ .4986990E+02	+ .4452270E+02	
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	+ .4989204E+02	+ .4443701E+02	
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	+ .4989333E+02	+ .4442797E+02	
	+ .1214555E+06	+ .2941287E+04	+ .5294312E+04
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	+ .4269596E+02	+ .1887375E+03	
	+ .4493096E+02	+ .1328374E+03	
	+ .4702366E+02	+ .9869799E+02	

	+ .4880555E+02	+ .7809472E+02	
	+ .502F431E+02	+ .6585644E+02	
8	+ .5131774E+02	+ .5874902E+02	
7	+ .5207575E+02	+ .5474169E+02	
5	+ .5245567E+02	+ .5255712E+02	
9	+ .5269806E+02	+ .5140185E+02	
2	+ .5282794E+02	+ .5080444E+02	
3	+ .5289532E+02	+ .5050000E+02	
6	+ .5292964E+02	+ .5034643E+02	
01	+ .5294698E+02	+ .5026928E+02	
11	+ .5295565E+02	+ .5023095E+02	
21	+ .5296003E+02	+ .5021118E+02	
	+ .5296218E+02	+ .5020214E+02	
	+ .5296335E+02	+ .5019702E+02	
	+ .5296389E+02	+ .5019409E+02	
	+ .1169864E+06	+ .2833052E+04	+ .5099492E+04
	+ .2881599E+03	+ .5019198E+02	+ .5296389E+02
	+ .4541598E+02	+ .1525571E+03	
	+ .4788316E+02	+ .1138559E+03	
	+ .5014087E+02	+ .9026440E+02	
	+ .5220175E+02	+ .7602905E+02	
	+ .5385899E+02	+ .6755468E+02	
	+ .5517899E+02	+ .6260327E+02	
	+ .5596749E+02	+ .5978491E+02	
	+ .5650437E+02	+ .5823266E+02	
	+ .5681437E+02	+ .5740185E+02	
	+ .5699284E+02	+ .5696972E+02	
	+ .5707098E+02	+ .5674975E+02	
	+ .5711625E+02	+ .5663842E+02	
	+ .5713929E+02	+ .5658154E+02	
	+ .5715083E+02	+ .5655322E+02	
	+ .5715660E+02	+ .5653906E+02	
	+ .5715946E+02	+ .5652198E+02	
	+ .5716088E+02	+ .5652856E+02	
	+ .1115989E+06	+ .2702583E+04	+ .4864648E+04
	+ .2931599E+03	+ .5652499E+02	+ .5716088E+02
	+ .4936798E+02	+ .1220329E+03	
	+ .5214355E+02	+ .9851098E+02	
	+ .5475358E+02	+ .8420043E+02	
	+ .5709811E+02	+ .7556591E+02	
	+ .5909932E+02	+ .7040600E+02	
	+ .6066740E+02	+ .6736352E+02	
	+ .6181889E+02	+ .6560498E+02	
	+ .6259616E+02	+ .6461499E+02	
	+ .6305424E+02	+ .6407373E+02	
	+ .6331919E+02	+ .6378686E+02	
	+ .6346133E+02	+ .6363940E+02	
	+ .6353549E+02	+ .6356323E+02	
	+ .6357308E+02	+ .6352563E+02	
	+ .6359226E+02	+ .6350659E+02	
	+ .6360203E+02	+ .6349633E+02	
	+ .6360668E+02	+ .6349218E+02	
	+ .6360926E+02	+ .6348925E+02	
	+ .1045412E+06	+ .2531668E+04	+ .4557000E+04
	+ .2981599E+03	+ .6348699E+02	+ .6360926E+02

END OF JOB

8  
9  
10  
11  
12

```

038908 C AMMONIA
038908 READ,TN
038914 READ,PK,ZC,AN
038928 READ,TC,PC,VC,R
038940 H=1
038948 1 READ,T,P,V
038950 TN=1.0-TN
038968 AK=(1./(1.-BK))-ZC
03897E CK=3.49
038986 Q=TC**TM
03899C S=VC**AN
0389P4 T1=T**TN
0389CC U=CK*TC-(CK-AK)*Q*T1
0389FA A=R*S*D
0389FA U=VC**1.5
038A10 B=BK**1
038A1C D2=CK*TC-TN*(CK-AK)*Q*T1
038A3E V=.8*V
038A4A BN=AN+1.0
038A56 4 C=V**(-BN)
038A78 E=V**.5
038A90 F=V**(-AN)
038APU G=V-B/E
038AC2 IF(G)6,6,7
038ADU 6 V=1.01*(B**0.6667)
038AFC GN TU 4
038AF0 7 P1=(R*T/G)-A*C
038B0A PRINT,V,P1
038B1C IF(ABS(P1-P)-0.005)2,2,5
038B44 5 H=V**(-1.5)
038B64 W=V**(-BN-1.0)
038B88 W1=R*T*(1.+R**1/2.)/(G**2.)
038BBA PV=BN*A*W-W1
038BCE DP=P-P1
038BDA DV=(DP/PV)/2.
038BFA V1=V+DV
038BF6 IF(V1-V)2,2,8
038C06 8 V=V1
038C0E GN TU 4
038C12 2 DH=R*T-P1*V+K*S*U?F/AN
038C3E CH=DH*1.987/62.05
038C4E BH=CH*1.8
038C5A PRINT,DH,CH,BH
038C70 PRINT,T,P,V
038C84 N=N+1
038C90 IF(N-12)1,1,3
038CA0 3 STOP
038CA4 END

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+ .1968990E+02	+ .1543970E+03	
+ .1968910E+02	+ .9928941E+04	
+ .2020869E+02	+ .6299320E+04	
+ .2058630E+02	+ .3928060E+04	
+ .2100320E+02	+ .2397595E+04	
+ .2142355E+02	+ .1425828E+04	
+ .2160520E+02	+ .8225102E+03	
+ .2211331E+02	+ .4590097E+03	
+ .2233332E+02	+ .2479920E+03	
+ .2247355E+02	+ .1304500E+03	
+ .2255509E+02	+ .6739013E+02	
+ .2259950E+02	+ .3451831E+02	
+ .2262280E+02	+ .1709653E+02	
+ .2263475E+02	+ .9190917E+01	
+ .2264085E+02	+ .4901123E+01	
+ .2264387E+02	+ .2764892E+01	
+ .2264540E+02	+ .1690675E+01	
+ .2264610E+02	+ .1146972E+01	
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+ .2264685E+02	+ .6755371E+00	
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+ .2264691E+02	+ .6264640E+00	
+ .2264692E+02	+ .6123046E+00	
+ .2328620E+06	+ .5639707E+04	+ .1015140E+03
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+ .2075480E+02	+ .3617094E+04	
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+ .2298724E+02	+ .1053222E+01	
+ .2298727E+02	+ .1038085E+01	
+ .2298725E+02	+ .1026611E+01	
+ .2298057E+06	+ .550E187E+04	+ .1001733E+03
+ .2400000E+03	+ .1012399E+01	+ .2293720E+02
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+ .2127624E+02	+ .2694407E+04	
+ .2161787E+02	+ .1630906E+04	
+ .2234520E+02	+ .9621965E+03	
+ .2280805E+02	+ .5512314E+03	
+ .2317000E+02	+ .3061564E+03	
+ .2342164E+02	+ .1652264E+03	
+ .2357855E+02	+ .8756730E+02	
+ .2366820E+02	+ .4616038E+02	

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+ .2371691E+02 + .2403159E+02  
+ .2374220E+02 + .1305942E+02  
+ .2375511E+02 + .8116455E+01  
+ .2376164E+02 + .5328125E+01  
+ .2376492E+02 + .3938476E+01  
+ .2376657E+02 + .3237304E+01  
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+ .2569203E+02 + .5496215E+02  
+ .2579553E+02 + .3322558E+02  
+ .2585090E+02 + .2198999E+02  
+ .2587960E+02 + .1627392E+02  
+ .2589422E+02 + .1338964E+02  
+ .2590159E+02 + .1194213E+02  
+ .2590530E+02 + .1121386E+02  
+ .2590716E+02 + .1085107E+02  
+ .2590809E+02 + .1066821E+02  
+ .2590855E+02 + .1058007E+02  
+ .2590878E+02 + .1053395E+02  
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+ .2590896E+02 + .1049926E+02  
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+ .2590901E+02 + .1049047E+02  
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+ .2486894E+02 + .4195422E+03  
+ .2549161E+02 + .2422875E+03  
+ .2593444E+02 + .1305747E+03  
+ .2602411E+02 + .8006699E+02

+ .9745136E+04  
+ .2376820E+02

+ .9462296E+04  
+ .2472006E+02

+ .9160800E+04  
+ .2590901E+02

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+ .2651460F+02	+ .3150659F+02	
+ .2656797F+02	+ .2288281F+02	
+ .2559555F+02	+ .1849780F+02	
+ .2660957F+02	+ .1627540F+02	
+ .2661665F+02	+ .1517919F+02	
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+ .2662197F+02	+ .1433880F+02	
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+ .2825041E+02	+ .1421909E+03	
+ .2876448E+02	+ .9003115E+02	



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+ .2929597E+02	+ .4687231E+02	
+ .2940400E+02	+ .3878976E+02	
+ .2946095E+02	+ .3464624E+02	
+ .2949024E+02	+ .3254443E+02	
+ .2950511E+02	+ .3148730E+02	
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+ .2952006E+02	+ .3042553E+02	
+ .2952009E+02	+ .3042382E+02	
+ .1938776E+06	+ .4695121E+04	+ .8451210E+04
+ .3400000E+03	+ .3041999E+02	+ .2952009E+02
+ .2778395E+02	+ .4111684E+03	
+ .2963027E+02	+ .2612756E+03	
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+ .3955990E+02	+ .1547211E+03	
+ .4176620E+02	+ .1331267E+03	
+ .4378683E+02	+ .1200622E+03	
+ .4554724E+02	+ .1122214E+03	
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+	4988241E+02	+	1015627E+03	
+	4997350E+02	+	1015314E+03	
+	4991415E+02	+	1015161E+03	
+	4991950E+02	+	1015078E+03	
+	4992222E+02	+	1015040E+03	
+	1402601E+00	+	3541971E+04	+.6375542E+04
+	4000000E+03	+	1015000E+03	+.4992222E+02

END OF JOB

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03A108 C KAY
03A108 C METHANE
03A108 READ,TN
03A114 READ,PK,ZC,AN
03A128 READ,TC,PC,VC,R
03A140 N=1
03A148 1 READ,T,P,V
03A150 TM=1.0=TN
03A168 AK=(1./(1.-PK))-ZC
03A17E CK=2.25
03A186 Q=TC**TM
03A19C S=VC**AN
03A184 T1=T**TN
03A17C D=CK*TC-(CK-AK)*Q*T1
03A1FA A=R*S*D
03A1FA U=VC**1.5
03A210 B=BK**11
03A21C D2=CK*TC-TM*(CK-AK)*Q*T1
03A23E V=.8*V
03A24A BM=AN+1.0
03A256 4 C=V**(-BN)
03A278 E=V**.5
03A290 F=V**(-AN)
03A280 G=V-B/E
03A2C2 IF(G)6,6,7
03A2D0 6 V=1.01*(B**0.6667)
03A2FC GO TO 4
03A2F0 7 P1=(K*T/G)-A*C
03A30A PRINT,V,P1
03A31C IF(ABS(P1-P)-0.005)2,2,5
03A344 5 H=V**(-1.5)
03A364 W=V**(-BN-1.0)
03A388 W1=P*T*(1.+B**11/2.)/(G**2.)
03A39A FV=BN*A*W-W1
03A3CE DP=P-P1
03A3DA DV=(DP/PV)/2.
03A3FA V1=V+DV
03A3F6 IF(V1-V)2,2,6
03A406 8 V=V1
03A40E GO TO 4
03A412 2 DH=P*T-D1*V+R*S*D2*F/AN
03A43E CH=DH*1.977/82.05
03A44E BH=CH*1.8
03A45A PRINT,DH,CH,BH
03A470 PRINT,I,P,V
03A484 N=N+1
03A490 IF(N-15)1,1,3
03A4A0 3 STOP
03A4A4 END

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+ .3034626E+02	+ .1111823E+05	
+ .3034436E+02	+ .7277710E+04	
+ .3061617E+02	+ .4726574E+04	
+ .3117561E+02	+ .3037702E+04	
+ .3162852E+02	+ .1925592E+04	
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+ .3275460E+02	+ .7312014E+03	
+ .3334560E+02	+ .4342207E+03	
+ .3367886E+02	+ .2501306E+03	
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+ .3503746E+02	+ .5014648E+00	
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+ .3503796E+02	+ .4274902E+00	
+ .3503797E+02	+ .4250486E+00	
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+ .1016999E+03	+ .4169999E+00	+ .3503799E+02
+ .3039999E+02	+ .1143850E+05	
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+ .3658767E+02	+ .1474121E+01	
+ .3658775E+02	+ .1466064E+01	
+ .3658776E+02	+ .1461425E+01	
+ .7945225E+05	+ .1924089E+04	+ .3463360E+04
+ .1161999E+03	+ .1458999E+01	+ .3658776E+02

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+3271629F+02	+1309870F+04	
+3355480F+02	+8655583F+03	
+3447132F+02	+5293171F+03	
+3539579F+02	+3109420F+03	
+3624395F+02	+1857347F+03	
+3694970F+02	+1057705F+03	
+3746971F+02	+5917822F+02	
+3781291F+02	+3290283F+02	
+3801834F+02	+1804080F+02	
+3813265F+02	+1117671F+02	
+3819331F+02	+7273437F+01	
+3822459F+02	+5317232F+01	
+3824049F+02	+4325439F+01	
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+3825254F+02	+3581054F+01	
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+3825607F+02	+3307037F+01	
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+3794505F+02	+1458647F+03	
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+4324160F+02	+1143359F+02	

	+ .7112862F+05	+ .1722759F+04	+ .3100964F+04
	+ .1522999F+03	+ .1142999F+02	+ .4324166F+02
6	+ .3839999F+02	+ .3260175F+03	
7	+ .4012312E+02	+ .2058041F+03	
5	+ .4161372E+02	+ .1299510F+03	
9	+ .4335873E+02	+ .8328686F+02	
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8	+ .4564945E+02	+ .3871313F+02	
6	+ .4633232E+02	+ .2928393F+02	
01	+ .4675802E+02	+ .2408569F+02	
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	+ .4722936E+02	+ .1876706E+02	
	+ .4725726E+02	+ .1857958E+02	
	+ .4726625E+02	+ .1848583E+02	
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	+ .4546044E+02	+ .1133774E+03	
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	+ .4961952E+02	+ .5832177E+02	
	+ .5129460E+02	+ .4580200E+02	
	+ .5259635E+02	+ .3841992E+02	
	+ .5351547E+02	+ .3417919E+02	
	+ .5410409E+02	+ .3182006E+02	
	+ .5444993E+02	+ .3055029E+02	
	+ .5464031E+02	+ .2988574E+02	
	+ .5474073E+02	+ .2954416E+02	
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	+ .5481852E+02	+ .2928466E+02	
	+ .5483177E+02	+ .2924121E+02	
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	+ .5484417E+02	+ .2919970E+02	
	+ .6130691E+05	+ .1464665E+04	+ .2672395E+04
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	+ .6030264E+02	+ .3477146E+02	
	+ .6030439E+02	+ .3476831E+02	
	+ .5779503E+05	+ .1399376E+04	+ .2519875E+04
	+ .1820006E+03	+ .3476599E+02	+ .6030439E+02
	+ .3020573E+02	+ .1766707E+05	
	+ .3034690E+02	+ .1163871E+05	
	+ .3054658E+02	+ .7626076E+04	
	+ .3082182E+02	+ .4960109E+04	

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+ .3119840E+02	+ .3194359E+04	
+ .3165472E+02	+ .2030646E+04	
+ .3221410E+02	+ .1209837E+04	
+ .3203689E+02	+ .7700622E+03	
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	+ .1803999F+03	+ .3295999F+02	+ .5841810E+02
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0	+ .3270422F+02	+ .1329055F+04	
1	+ .3352009F+02	+ .8249201F+03	
2	+ .3439973F+02	+ .5022260F+03	
3	+ .3527192F+02	+ .2909614F+03	
4	+ .3605702F+02	+ .1735217F+03	
5	+ .3669082F+02	+ .9814965F+02	
6	+ .3714662F+02	+ .5437329F+02	
7	+ .3744000F+02	+ .2991577F+02	
8	+ .3761215E+02	+ .1674731F+02	
9	+ .3770661E+02	+ .9801572E+01	
0	+ .3775635E+02	+ .6332763F+01	
1	+ .3778180E+02	+ .4543945F+01	
2	+ .3779479F+02	+ .3645019F+01	
3	+ .3780131F+02	+ .3191894F+01	
4	+ .3780450E+02	+ .2908261F+01	
5	+ .3780622E+02	+ .2851800E+01	
6	+ .3780705E+02	+ .2798095F+01	
7	+ .3780740F+02	+ .2768066F+01	
8	+ .3780750E+02	+ .2753417F+01	
9	+ .3780775E+02	+ .2749267F+01	
0	+ .3780781F+02	+ .2743406F+01	
1	+ .7765260E+03	+ .1800509F+04	+ .3384910E+04
2	+ .1253999F+03	+ .2738799F+01	+ .3780781E+02
3	+ .3599990E+02	+ .5408205F+03	
4	+ .3742637E+02	+ .3350632E+03	
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7	+ .4141712E+02	+ .7742797F+02	
8	+ .4234165E+02	+ .4859594F+02	
9	+ .4299320F+02	+ .3199877F+02	
0	+ .4340710E+02	+ .2277856F+02	
1	+ .4364819F+02	+ .1703325F+02	
2	+ .4377989F+02	+ .1525341F+02	
3	+ .4384902E+02	+ .1393237F+02	
4	+ .4388450E+02	+ .1326310E+02	
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8	+ .4391833F+02	+ .1263061F+02	
9	+ .4391940E+02	+ .1260996E+02	
0	+ .4392004F+02	+ .1259912E+02	
1	+ .4392033F+02	+ .1259320E+02	
2	+ .4392047F+02	+ .1259130E+02	
3	+ .7044295E+03	+ .1705911E+04	+ .3070639F+04
4	+ .1545999F+03	+ .1258799E+02	+ .4392047E+02
5	+ .3999990E+02	+ .2463469F+03	
6	+ .4187500E+02	+ .1509510E+03	
7	+ .4368022E+02	+ .1016918E+03	
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9	+ .4663912E+02	+ .4777709E+02	
0	+ .4704427E+02	+ .3594360E+02	
1	+ .4832571E+02	+ .2922460E+02	
2	+ .4874514E+02	+ .2553900E+02	
3	+ .4899373E+02	+ .2359300E+02	
4	+ .4911224E+02	+ .2256811E+02	
5	+ .4917907E+02	+ .2205053E+02	
6	+ .4921315E+02	+ .2179052E+02	
7	+ .4923042E+02	+ .2165893E+02	
8	+ .4923910E+02	+ .2159326E+02	
9	+ .4924340E+02	+ .2155957E+02	
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1	+ .4924670E+02	+ .2153580E+02	
2	+ .4924720E+02	+ .2153100E+02	
3	+ .4924770E+02	+ .2152750E+02	
4			+ .2857053E+04



	+ .1620999F+03	+ .2152699F+02	+ .4924726F+02
	+ .4559999F+02	+ .1256252F+03	
0	+ .4792482E+02	+ .6807446F+02	
7	+ .5025665F+02	+ .6507690F+02	
5	+ .5227595E+02	+ .5114235F+02	
9	+ .5394946F+02	+ .4261396F+02	
2	+ .5522415F+02	+ .3792261F+02	
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6	+ .566307F+02	+ .3360473F+02	
01	+ .5698532F+02	+ .3278051F+02	
11	+ .5716116F+02	+ .3235131F+02	
21	+ .5725352F+02	+ .3213085F+02	
	+ .5730085E+02	+ .3201904E+02	
	+ .5732475F+02	+ .3196313E+02	
	+ .5733677F+02	+ .3193530F+02	
	+ .5734284E+02	+ .3192114E+02	
	+ .5734588F+02	+ .3191406E+02	
	+ .5734739F+02	+ .3191040E+02	
	+ .5962806F+03	+ .1444009F+04	+ .2599215E+04
	+ .1793995F+03	+ .3190699F+02	+ .5734739F+02

END OF IUP

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XT(I)=XT(I)+X(I)  
 03A108 C KAY  
 03A108 C PROpane  
 03A108 READ, TN  
 03A114 READ, RK, ZC, AN  
 03A128 READ, TC, PC, VC, R  
 03A140 N=1  
 03A148 1 READ, T, P, V  
 03A150 TM=1, 0=TN  
 03A168 AK=(1./(1.-RK))-ZC  
 03A17E CK=3.68  
 03A180 Q=TC\*\*TM  
 03A190 S=VC\*\*AN  
 03A1P4 T1=T\*\*TN  
 03A1CC D=CK\*TC-(CK-AK)\*Q\*T1  
 03A1FA A=R\*S\*D  
 03A1FA U=VC\*\*1.5  
 03A210 B=BK\*\*1  
 03A21C D2=CK\*TC-TK\*(CK-AK)\*Q\*T1  
 03A23E V=.8\*V  
 03A24A BN=AN+1, 0  
 03A250 4 C=V\*\*(-BN)  
 03A278 E=V\*\*.5  
 03A290 F=V\*\*(-AN)  
 03A2R0 G=V-B/E  
 03A2C2 IF(G)6,6,7  
 03A2D0 6 V=1.01\*(B\*\*0.6667)  
 03A2EC GO TO 4  
 03A2F0 7 P1=(R\*T/G)-A\*C  
 03A30A PRINT, V, P1  
 03A31C IF(ABS(P1-P)-0.005)2,2,5  
 03A344 5 H=V\*\*(-1.5)  
 03A364 W=V\*\*(-BN-1, 0)  
 03A388 W1=R\*T\*(1.+R\*\*1/2, 1)/(G\*\*2, .)  
 03A3RA PV=BN\*A\*W-W1  
 03A3CE DP=P-P1  
 03A3DA DV=(DP/PV)/2.  
 03A3FA V1=V+DV  
 03A3F6 IF(V1-V)2,2,8  
 03A406 8 V=V1  
 03A40E GO TO 4  
 03A412 2 DH=R\*T-P1\*V+R\*S\*D2\*F/AN  
 03A43E CH=DH\*1.987/82.05  
 03A44E BP1=Ch\*1, 0  
 03A45A PRINT, DH, CH, BP1  
 03A470 PRINT, T, P, V  
 03A484 N=N+1  
 03A490 IF(N-15)1,1,3  
 03A4A0 3 STOP  
 03A4A4 END

\*RUN

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+ .5892402E+02	+ .1607667E+05	
+ .5919750E+02	+ .1092770E+05	
+ .5958123E+02	+ .7143242E+04	
+ .6010425E+02	+ .4630074E+04	
+ .6078952E+02	+ .2967225E+04	
+ .6164202E+02	+ .1873501E+04	
+ .6263471E+02	+ .1100729E+04	
+ .6370005E+02	+ .7024152E+03	
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+ .6709445E+02	+ .3608374E+02	
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+ .6743084E+02	+ .8005371E+00	
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+ .7031030E+02	+ .2521972E+01	
+ .7032450E+02	+ .1658447E+01	
+ .7033168E+02	+ .1228759E+01	
+ .7033525E+02	+ .1012695E+01	
+ .7033703E+02	+ .9057617E+00	
+ .7033795E+02	+ .8510742E+00	
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+ .7033862E+02	+ .8095703E+00	
+ .7033872E+02	+ .8041992E+00	
+ .7033879E+02	+ .7983398E+00	
+ .1867920E+06	+ .4523527E+04	+ .8142348E+04
+ .2251999E+03	+ .7954999E+00	+ .7033879E+02
+ .6239999E+02	+ .2155051E+04	
+ .6376545E+02	+ .1358889E+04	
+ .6577285E+02	+ .8426062E+03	

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+ .7021499E+02	+ .1757482E+03	
+ .7141290E+02	+ .9882714E+02	
+ .7226595E+02	+ .5428613E+02	
+ .7280986E+02	+ .2948291E+02	
+ .7312663E+02	+ .1617114E+02	
+ .7329960E+02	+ .9229003E+01	
+ .7339035E+02	+ .5674072E+01	
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+ .7346044E+02	+ .2970214E+01	
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+ .7347827E+02	+ .2287353E+01	
+ .7348125E+02	+ .2173828E+01	
+ .7348271E+02	+ .2118896E+01	
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+ .7348411E+02	+ .2065185E+01	
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+ .7057574E+02	+ .3112587E+03	
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+ .7763558E+02	+ .4626953E+01	
+ .7763575E+02	+ .4623046E+01	
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+ .8285334E+02	+ .1075073E+02	
+ .8293217E+02	+ .9723876E+01	
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+ .8301237E+02	+ .8690673E+01	
+ .1637057E+06	+ .3964451E+04	+ .7136007E+04
+ .2948999E+03	+ .8686999E+01	+ .8301237E+02
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+ .1109980E+03	+ .2800268E+02	
+ .1353053E+06	+ .3276681E+04	+ .5999023E+04
+ .3473999E+03	+ .2800000E+02	+ .1109980E+03

END OF JOB



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03A108 C YESAVAGE
03A108 C METHANE
03A108 READ,TN
03A114 READ,BK,ZC,AN
03A128 READ,TC,PC,VC,K
03A140 N=1
03A148 1 READ,T,D,V
03A150 TM=1.0=TN
03A168 AK=(1./(1.-BK))-ZC
03A17E CK=2.25
03A186 Q=TC**TM
03A190 S=VC**AN
03A1P4 T1=T**TN
03A1CC D=CK*TC-(CK-AK)*Q*T1
03A1FA A=R*S*D
03A1FA U=VC**1.5
03A210 B=BK**1
03A21C D2=CK*TC-TM*(CK-AK)*Q*T1
03A23E V=.8*V
03A24A BN=AN+1.0
03A256 4 C=V**(-BN)
03A278 E=V**.5
03A290 F=V**(-AN)
03A2R0 G=V-B/E
03A2C2 IF(C)6,6,7
03A2D0 6 V=1.01*(B**0.5667)
03A2FC GO TO 4
03A2F0 7 P1=(R*T/G)-A*C
03A30A PRINT,V,P1
03A31C IF(ABS(P1-P)-0.005)2,2,5
03A344 5 H=V**(-1.5)
03A364 W=V**(-BN-1.0)
03A388 W1=P*T*(1.+P**1/2.)/(C**2.)
03A3BA PV=BN*A*w-w1
03A3CE DP=P-P1
03A3DA DV=(DP/PV)/2.
03A3FA V1=V+DV
03A3F6 IF(V1-V)2,2,6
03A406 8 V=V1
03A40E GO TO 4
03A412 2 DH=R*T=P1*V+K*S*D2*F/AN
03A43E CH=DH*1.997/62.05
03A44E BH=CH*1.8
03A45A PRINT,DH,CH,BH
03A470 PRINT,T,P,V
03A484 N=N+1
03A490 IF(N-15)1,1,3
03A4A0 3 STOP
03A4A4 END

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+ .3487957E+02	+ .2839111E+01	
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+ .3399644F+02	+ .6496035F+03	
+ .3489846E+02	+ .3917556F+03	
+ .3575619F+02	+ .2307661E+03	
+ .3649272F+02	+ .1325197F+03	
+ .3705782F+02	+ .7432495F+02	
+ .3744446F+02	+ .4108544F+02	
+ .3768275F+02	+ .2282324F+02	
+ .3781806F+02	+ .1312963F+02	
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+ .3796252E+02	+ .3284667F+01	
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+ .3796737F+02	+ .2963134F+01	
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+ .3660221E+02	+ .2343059F+03	
+ .3777665F+02	+ .1378474F+03	
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+ .3914804F+02	+ .4609887F+02	
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+ .7477837E+03	+ .1810902F+04	+ .3259623E+04
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+ .3763790F+02	+ .2465031F+03	
+ .3911016F+02	+ .1491584F+03	
+ .4021972E+02	+ .8981665F+02	
+ .4109521E+02	+ .5450268F+02	
+ .4171534E+02	+ .3412159F+02	
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+ .3759999F+02	+ .3845500F+03	
+ .3923719F+02	+ .2399880F+03	
+ .4086161F+02	+ .1498654F+03	
+ .4236210F+02	+ .9444799F+02	
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+ .5627777E+02 + .3031005E+02

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+ .4729629E+02	+ .1853393E+02	
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+ .4730482E+02	+ .1844053E+02	
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+ .5366561E+02	+ .2770263E+02	
+ .5366723E+02	+ .2769653E+02	
+ .5366800E+02	+ .2769311E+02	
+ .6214399E+03	+ .1504930E+04	+ .2708880E+04
+ .1751999E+03	+ .2768998E+02	+ .5366800E+02

END OF JOB

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03A108 C YESAVAGE
03A108 C PROPANE
03A108 READ,TN
03A114 READ,BK,ZC,AN
03A128 READ,TC,PC,VC,R
03A140 N=1
03A148 1 READ,T,P,V
03A150 TM=1,C=TN
03A168 AK=(1./(1.=BK))-ZC
03A17E CK=3.68
03A186 Q=TC**TM
03A19C S=VC**AN
03A1B4 T1=T**TN
03A1CC D=CK*TC=(CK-AK)*Q*T1
03A1FA A=R*S*D
03A1FA U=VC**1.5
03A210 B=BK*U
03A21C D2=CK*TC-TM*(CK-AK)*Q*T1
03A23E V=.8*V
03A24A BN=AN+1.0
03A256 4 C=V**(-BN)
03A278 E=V**.5
03A290 F=V**(-AN)
03A2P0 G=V-B/E
03A2C2 IF(C)6,6,7
03A2D0 6 V=1.01*(B**0.6667)
03A2FC GO TO 4
03A2F0 7 P1=(K*T/G)-A*C
03A30A PRINT,V,P1
03A31C IF(ABS(P1-P)-0.005)2,2,5
03A344 5 H=V**(-1.5)
03A364 W=V**(-BN-1.0)
03A388 W1=R*T*(1.+B**U/2.)/(G**2.)
03A3BA PV=BN*A*W-W1
03A3CE DP=P-P1
03A3DA DV=(DP/PV)/2.
03A3EA V1=V+DV
03A3F6 IF(V1-V)2,2,6
03A406 8 V=V1
03A40E GO TO 4
03A412 2 DH=R*T=P1*V+K*S*D2*F/AN
03A43E CH=DH*1.987/82.05
03A44E BH=CH*1.8
03A45A PRINT,DH,CH,BH
03A470 PRINT,T,P,V
03A484 N=N+1
03A490 IF(N=15)1,1,3
03A4A0 3 STOP
03A4A4 END

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+ .6461251E+02	+ .3996655E+03	
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END OF JOB