REFERENCES

Baker ,T. H. , and Roth , J. A. Vapor - Liquid Equilibria for Binary systems . Journal of Chemical Engineering Data 25 (1980) : 108-124 .

Bigg , D. C.; Banerjee , S.C. ; and Doraiswamy , L . K. Vapor - Liquid Equilibria for Diethyamine - Methanol , Ethanol - Methanol . Canadian Journal of Chemical Engineering 60 (Dec 1988) :308-315.

Blasdel , J. W.; Poling , B. E.; and Manley , D. B. Vapor - Liquid Equilibria for the Acetonitile / Diethyamine System . Experimental Results from The Design Institute for Physical Property Data 83 (1987) :11-17,23-38 ,82-86, 91-103 .

Cea , P. ; Lafuente , C.; Sanz , M. S.; and Royo , M.F. Isobaric Vapor - liquid Equilibrium Measurements on 2-Chlorobutane + Isomeric Butanols at 60.0 KPa and 101.3 KPa . Journal of Chemical Engineering Data 40 (1995) :692-695 .

Chang , H.L ., and Gerald , D. H. Vapor - Liquid Equilibria in the systems Toluene / Napthalene and Cyclohexane / Napthalene . Journal of Chemical Engineering Data 38 (1993) :320-333 .

Chen , G., and Chao , C.K. Vapor - Liquid Equilibria in the Mixtures of Methyl formate + Acetone . Experimental Results from The Design Institute for Physical Property Data 83 (1987) :94-96.

Claude , J.B., and Jean , B. S. Vapor - Liquid Equilibria for the Ethane - Propane System at low temperature. Journal of Chemical Engineering Data 33 (1988) :111-115 .

Conti, J. J., and Gilmont , R. Vapor - Liquid Equilibria for Methanol - 1 octanol , Ethanol - 1 octanol . Journal of Chemical Engineering Data 40 (1995) :238-242 .

Cunningham , R.J., and Jones , K.D. Experimental Results and Data Compilation Procedures . Experimental Results from The Design Institute for Physical Property Data 86 (1990) :23-24 , 40-41 .

Ewell , R.H.; Harrison , J. M.; and Berg , J.M. Nonideal liquid mixtures containing polar species. J. Ind. Eng. Chem 36 (1994):871-874 .

Gultekin , N. Vapor - liquid Equilibria at 1 atm for Binary and Ternary Systems Composed of Benzene , Toluene , and m-Xylene . Journal of Chemical Engineering Data 35 (1990) :132-136 .

Harmens , A. Propylene - Propane Phase Equilibrium from 230 to 350 K. Journal of Chemical Engineering Data 30 (1985) :230-233 .

Hiaki , T. ; Takahashi ,K. ;Tsuji ,T. ; Hongo , M. ; and Kojima , K. Vapor - liquid Equilibria of Ethanol - Octane at 343.15 K and 1- Propanol + Octane at 358.15 K. Journal of Chemical Engineering Data 40 (1995) :271-273 .

Hongo , M. ; Tsuji, T. ; Fukuchi , K. ; and Arsi, Y. Vapor - liquid Equilibria of Methanol + Hexane , Methanol + Heptane ,Ethanol + Hexane ,Ethanol + Heptane , and Ethanol + Octane at 298.15 K . Journal of Chemical Engineering Data 39 (1994) :688-691 .

Huang , S.S. , and Robinson , B.D. Equilibrium Phase Properties of the Ethylcyclohexane & Hydrogen sulfide . Journal of Chemical Engineering Data 30 (1985) :154-157 .

Ikarl , A. ;Hatete , Y. ; Futal , M.; and Kurokawa , Y. Vapor - liquid Equilibria of a Slight Amount of Water in Eight Organic Solvents at atmospheric Pressure. Journal of Chemical Engineering Data 30 (1985) :63-165 .

Jan , S. D. ; Shiau ,Y.H. ; and Tsai , N.F. Vapor - liquid Equilibria of n-Hexane & Cyclohexane and the three constitute binary systems at 101.0 KPa . Journal of Chemical Engineering Data 39 (1994) :438-440 .

Kato,M. ;Yamaguchi , M. ; and Yoshikawa, H. Vapor - liquid Equilibria at 100 KPa for Propionic acid + Carbontetrachloride or 2- Butane . Journal of Chemical Engineering Data 35 (1990) :85-89 .

Khurma , R.J. ; Muthu, O. ; Munjal , S. ; and Buford , D. S. Total - Pressure Vapor - liquid Equilibrium Data for Binary Systems of 1-Chlorobutane with Ethyl Acetate ,Acetonitile , Nitromethane , and Acetne . Journal of Chemical Engineering Data 28 (1982) :86-93 .

Klara , M. S. ; Mohamed , S. R. ; Dempsey, M. D. ; and Holder, D. G. Vapor - liquid Equilibria for the Binary Systems of Benzene / Toluene . Journal of Chemical Engineering Data 32 (1987) :143-147 .

Mato , F. ; Gonzalez,G. ; and Arroya , J. F. Vapor - liquid Equilibria at 760 mmHg in the Binary Systems Cyclohexene - 1,2 Dichloroethane and Cyclohexane - 1,2 Dichloroethane . Journal of Chemical Engineering Data 34 (1989) :179-182 .

Miller , E. Vapor - liquid Equilibria of Water - Hydrogen Chloride Solutions below 273 K. Journal of Chemical Engineering Data 28 (1983) :363-367 .

Monfort , P.J. Vapor - liquid Equilibria for Benzene - Acetonitile and Toluene - Acetonitile Mixtures at 343.15 K . Journal of Chemical Engineering Data 28 (1983) :24-27 .

Moon , M.H. ; Ochi , K. ; and Kojima , K. Vapor - liquid Equiiibria for the Methyl Ethyl Ketone + Water System with Limited Miscibility . Journal of Chemical Engineering Data 40 (1995) :468-471 .

Mullins , S.R. ; Oehlert , L . A. ; Wileman ,K. P. ; and Manly , D. B. Experimental Vopor-liquid Equilibria for Methanol - Dimethylsulfide . Experimental Results from the Design Institute for Physical Property Data 85(1989) :6-10 ,94-96.

Nagata ,I. Vapor - liquid Equilibria for Methyl Ethyl Ketone - Water . Canadian Journal of Chemical Engineering 50 (June 1972):386-388 .

Ninov , I.J. ; Stefanova , K.T. ; and Petrov , S.P. Vapor - liquid Equilibria at 101.3 KPa for Diethylamine + Chloroform . Journal of Chemical Engineering Data 40 (1995) :199-201 .

Reddy , S.B., and Subba Rao,V .B. Vapor - liquid Equilibrium Data of tert- Butyl Alcohol - Chlorobenzene at 101.3 KPa . Journal of Chemical Engineering Data 34 (1989) :26-28 .

Rodriguez , V.; Pardo , J.; and Urieta , S.J. Vapor Pressures of Binary Mixtures of Hexane + 1-Butanol + 2-Butanol at 298.15 K . Journal of Chemical Engineering Data 38 (1993) :350-352.

Rousseau , W.R. Vapor - liquid Equilibrium in Mixtures of 1,1 Dichloroethane and Acetaldehyde . Experimental Results from the Design Institute for Physical Property Data 83 (1987): 23-38.

Srivastava , R., and Buford , D. S. Total - Pressure Vapor - liquid Equilibrium Data for Binary Systems of Diethylamine with Acetone , Acetonitile ,and Methanol. Journal of Chemical Engineering Data 30 (1985) :308-313.

Triday , O. J., and Veas , C. Vapor - liquid Equilibrium for the System Cyclohexane - tert- Butyl Alcohol . Journal of Chemical Engineering Data 30 (1985) :171-173.

Vinod, M.S. ,and Bienkowski ,P.R. Genralized Quartic Equation of State for Pure Nonpolar Fluids. AIChE Journal 40 (January 1994) :152 - 159.

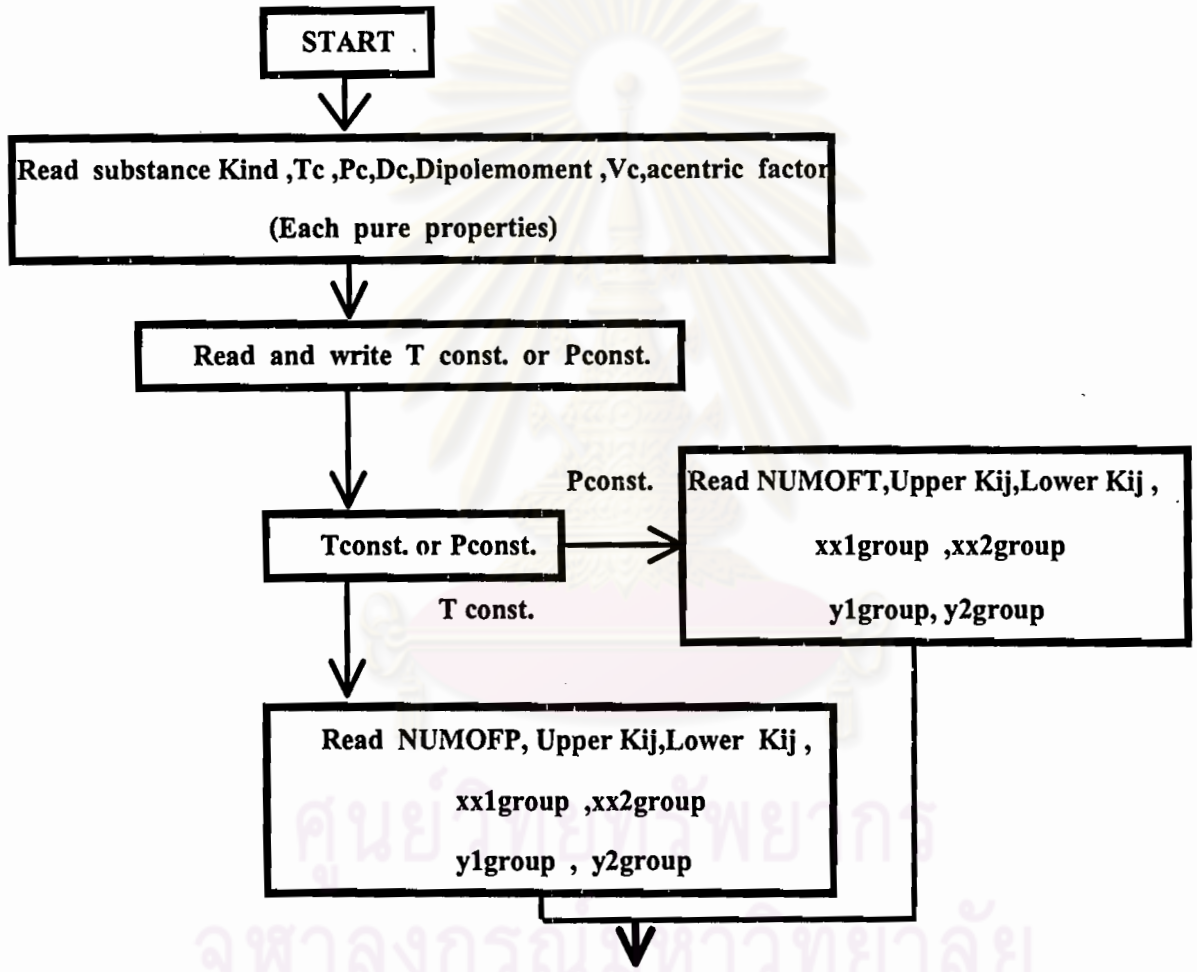
Wisniak , J. Isobaric Vapor - liquid Equilibrium Data in the systems Methyl Ethyl Ketone - p-Xylene . Journal of Chemical Engineering Data 35 (1990) :147-150.

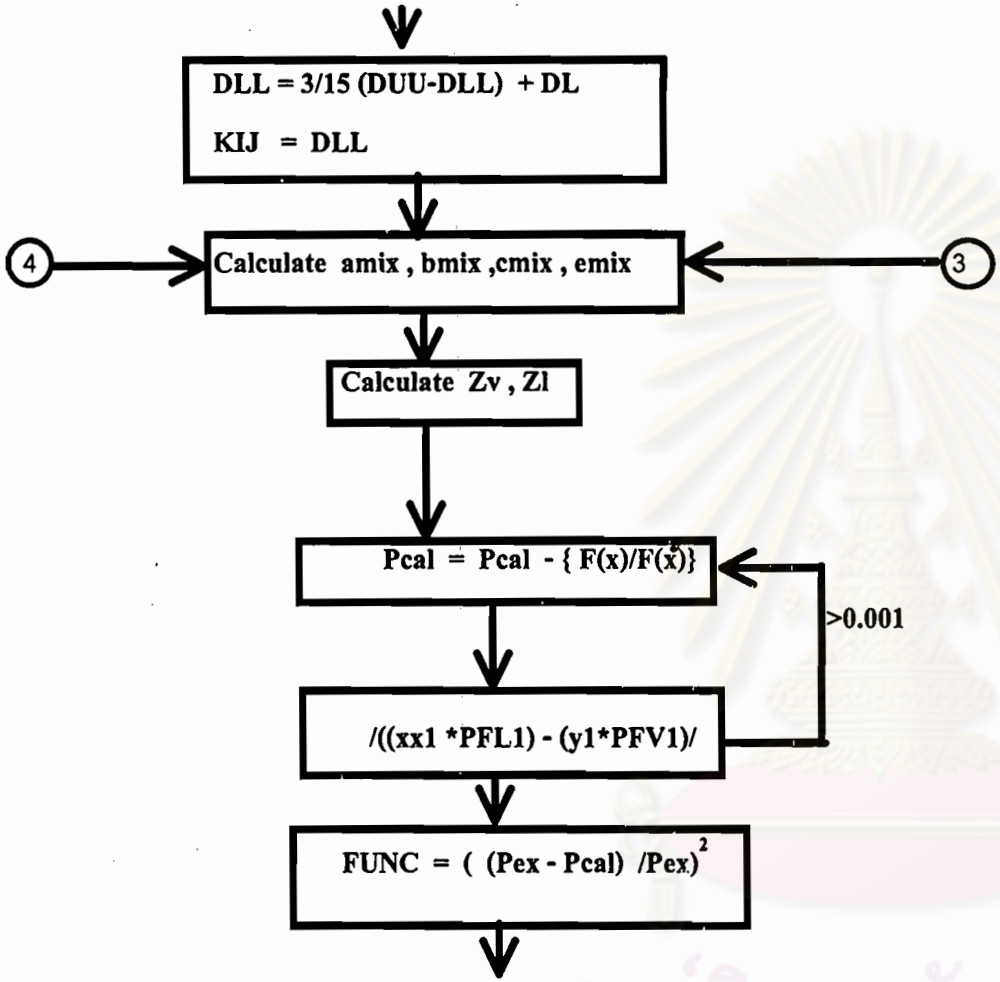
Wisniak , J., and Tamir A. Vapor - liquid Equilibria at 760 mmHg in the Systems Propyl Bromide - Methyl Metha acrylate and Vinyl Acetate - Propyl Bromide. Journal of Chemical Engineering Data 34 (1989) :17-19.

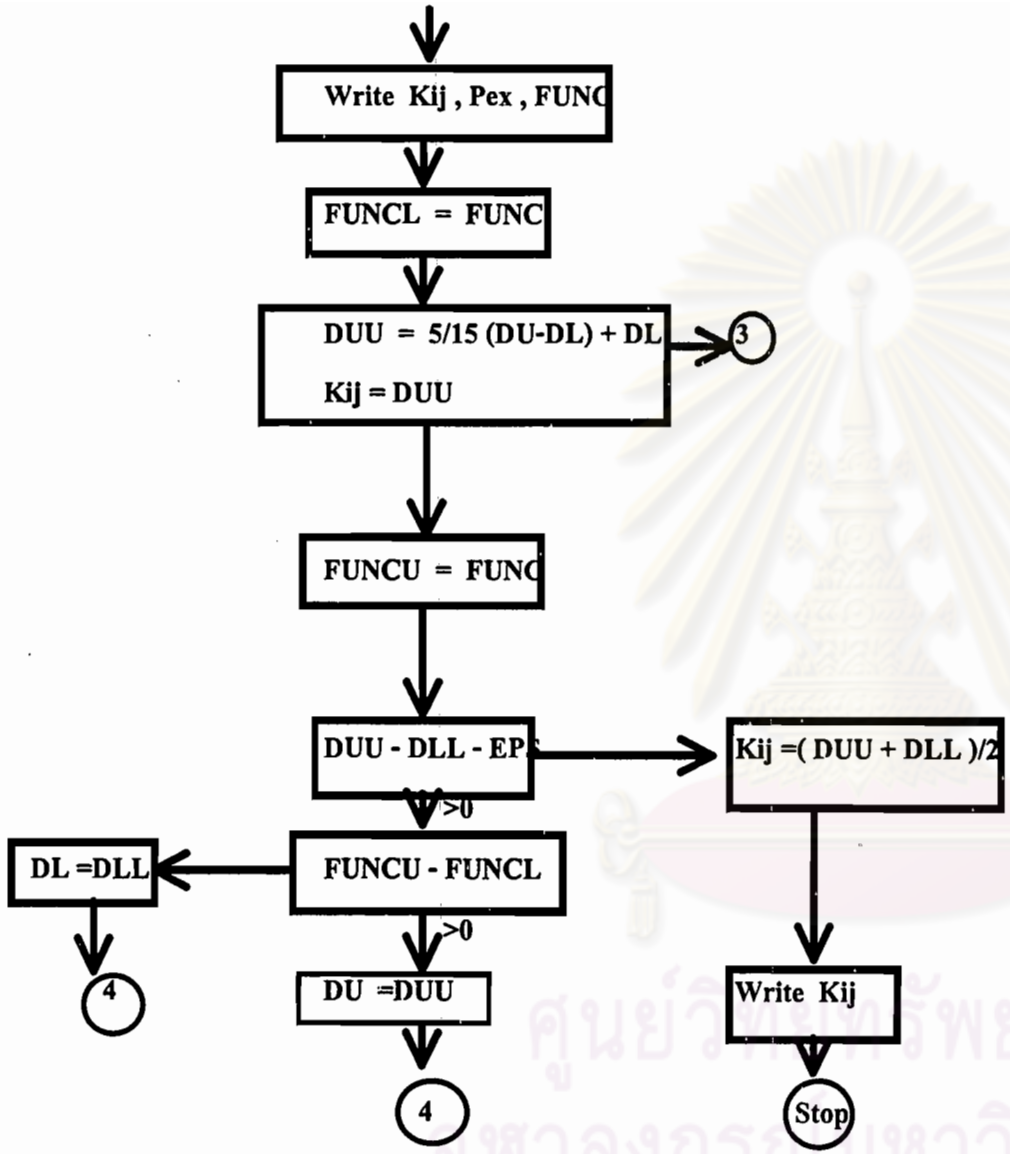
APPENDIX

APPENDIX A

FLOW CHART FOR PROGRAM CALCULATION







```
{PROGRAME FOR  QUARTIC  EQUATION OF STATE}

Program Quartic_Equation_of_state;
Uses Strings,CRT;
VAR BC1,BC2,VC1,VC2,P1,P2,Tc1,Tc2,B1,B2,BMIX,T,P,XX1,XX2,Y1,Y2:REAL;
   ER1,ER2,E1,E2,EMIX,W1,W2,DC1,DC2,pc1,pc2:REAL;

TR1,RcDipole1,Dipolemoment1,dipolemoment,redipole1,redipole2,X2,X3,X4,APLHA1,ALPHATR,
X5,X6,APLHA2,ar1,ac1,a1:REAL;
   C1,C3,CR1,CC1,X7,tempdep1,tempdep11:REAL;

TR2,Dipolemoment2,Z2,Z3,Z4,APLHA3,ALPHA1,ALPHA2,ALPHA3,ALPHATR1,Z5,Z6,ALPHA4,ar2,
ac2,a2:REAL;
   C2,C4,C5,C6,C7,C8,REMARK,CR2,CC2,Z7,tempdep2,tempdep22:REAL;
   aMIX,cMIX,Q1,Q2,Q3,Q4,O1,O2,O3:REAL;
   P1sat,P2sat,Tex,Pex,Ts,Te,ITV,Kij,min,Kanswer,Tope,SUM:REAL;
   NUMOFP,NUMOFT,COUNTIT,i:INTEGER;
   Pgroup:ARRAY[0..30]OF REAL;
   Pexgroup:ARRAY[0..30]OF REAL;
   Tgroup:ARRAY[0..30]OF REAL;
   XX1group:ARRAY[0..30]OF REAL;
   XX2group:ARRAY[0..30]OF REAL;
   Y1group:ARRAY[0..30]OF REAL;
   Y2group:ARRAY[0..30]OF REAL;
   zl,zv,ANSWER,DU,DL,EPS,DUU,DLL,FUNC,FUNCL,FUNCU,FUL:REAL;

   Input:text;
   Fname1,Fname2,Fname3,Fname4,substance1,substance2:Array [0..29] of Char;
   kind1,kind2:Array [0..9] of Char;
   Found1,Found2:Integer; {strpos}
   steady:Char;
   {Addition Variables}
   Po,Len:Integer;
   {test variables}
   sub1,sub2:string;
```

```
  output:text;

  Pexp:REAL;

FUNCTION J5(BMIX,AMIX,EMIX,N1,N2,M3,T,VL:REAL):REAL;
  VAR J51,J52,J53:REAL;
  BEGIN
  J51:=(2*2.8225*0.008314*BMIX*T/(N1*N1*N1));
  J52:=(AMIX*((2*VL)+EMIX-M3)/(N2*N2*N1*N1));
  J53:=((3*VL*VL)+(2*EMIX*VL)-(2*M3*VL)-(M3*EMIX))
     /(VL*VL*N2*N2*N1*N1);
  J5:=((-0.008314*T/(N1*N1))-J51+J52+(M3*CMIX*J53));
  END;
FUNCTION J9(CMIX,EMIX,M3,M4,N1,N2,T,VL:REAL):REAL;
  VAR J91,J92,J93,J94:REAL;
  BEGIN
  J91:=(M3*CMIX/(0.008314*T));
  J92:=(1/(N1*((M3*M3)+M4)));
  J93:=(1/(N2*((EMIX*EMIX)+M4)));
  J94:=(1/(VL*M3*EMIX));
  J9:=J91*(J92+J93-J94);
  END;
FUNCTION PH2(VL,M3,M4,EMIX:REAL):REAL;
  VAR PH21,PH22:REAL;
  BEGIN
  PH21:=(4*VL*VL*VL)-(6*M3*VL*VL)+(2*M3*M3*VL);
  PH22:=(3*EMIX*VL*VL)-(4*M4*VL)+(M3*M3*EMIX);
  PH2:=PH21+PH22;
  END;

FUNCTION S4(VL,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1:REAL):REAL;
  VAR S41,S42,S43:REAL;
  BEGIN
```

```
  S41:=(-1.2864*CMIX*((2*VL)+EMIX)/(VL*VL*N2*N2));
  S42:=(1.2864*AMIX*((2*VL)+EMIX-M3)/(N2*N2*N1*N1));
  S43:=((1.2864*1.2864*BMIX*CMIX)*PH1/(VL*VL*N2*N2*N1*N1));
   S4:=S41-S42-S43;
   END;
FUNCTION S7(VL,AMIX,CMIX,N1,N2,M3,T:REAL):REAL;
  VAR S71,S72,S73,S74:REAL;
  BEGIN
  S71:=(0.008314*T*(1.2864+2.8225)/(N1*N1));
  S72:=(2*2.8225*M3*0.008314*T/(N1*N1*N1));
  S73:=(1.2864*CMIX/(VL*N2*N1));
  S74:=1.2864*((AMIX*VL)+(M3*CMIX))/(VL*N2*N1*N1);
   S7:=S71+S72-S73-S74;
   END;
FUNCTION S8(VL,T,P,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1:REAL):REAL;
  VAR S81,S82,S83,S84:REAL;
  BEGIN
  S81:=(-0.008314*T/(N1*N1));
  S82:=(2*0.008314*2.8225*BMIX*T/(N1*N1*N1));
  S83:=(AMIX*((2*VL)+EMIX-M3)/(N2*N2*N1*N1));
  S84:=(M3*CMIX*PH1/(VL*VL*VL*N2*N2*N1*N1));
   S8:=(-1/(P*P))*(S81-S82+S83+S84);
   END;
FUNCTION S12(VL,T,M3,M4,M6,N1,N2,CMIX,EMIX:REAL):REAL;
  VAR S121,S122,S123:REAL;
  BEGIN
  S121:=(1/(VL*M4*M4));
  S122:=(1/(N1*N1*((M3*M3)+M4)));
  S123:=(1/(N2*((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)));
   S12:=((M6/2)*CMIX*EMIX/(0.008314*T))*(S121+S122-S123);
   END;
FUNCTION S13(CMIX,T,M3,M4,M7,N1:REAL):REAL;
  VAR S131,S132,S133,S134:REAL;
  BEGIN
  S131:=(M3*CMIX/(0.008314*T));
  S132:=((2*1.2864*M3)+M7);
  S133:=((M3*M3)+M4)*N1;
```

```
  S134:=(((M3*M3)+M4)*S133);
  S13:=S131*S132/S134;
  END;
FUNCTION S16(VL,T,N1,N2,M3,M4,EMIX:REAL):REAL;
  VAR S161,S162,S163:REAL;
  BEGIN
  S161:=(M3/(0.008314*T));
  S162:=(1/(N1*((M3*M3)+M4)));
  S163:=(1/(((EMIX*EMIX)+M4)*N2));
  S16:=S161*(S162+S163-(1/(VL*M4)));
  END;
FUNCTION S25(VL,T,CMIX,EMIX,N1,N2,M3,M4:REAL):REAL;
  VAR S251,S252,S253,S254:REAL;
  BEGIN
  S251:=(-M3/(((M3*M3)+M4)*((M3*M3)+M4)*N1));
  S252:=(1/(((EMIX*EMIX)+M4)*N2*N2));
  S253:=(((2*EMIX)+M3)/(((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)*N2));
  S254:=(1/(M4*EMIX*VL));
  S25:=(M3*CMIX/(0.008314*T))*(S251-S252-S253+S254);
  END;
FUNCTION  T5(BMIX,AMIX,EMIX,M1,M2,M3,T,VV:REAL):REAL;
  VAR T51,T52,T53:REAL;
  BEGIN
  T51:=(2*2.8225*0.008314*BMIX*T/(M1*M1*M1));
  T52:=(AMIX*((2*VV)+EMIX-M3)/(M2*M2*M1*M1));
  T53:=((3*VV*VV)+(2*EMIX*VV)-(2*M3*VV)-(M3*EMIX))
     /(VV*VV*M2*M2*M1*M1);
  T5:=((-0.008314*T/(M1*M1))-T51+T52+(M3*CMIX*T53));
  END;
FUNCTION T9(CMIX,EMIX,M3,M4,M1,M2,T,VV:REAL):REAL;
  VAR T91,T92,T93,T94:REAL;
  BEGIN
  T91:=(M3*CMIX/(0.008314*T));
  T92:=(1/(M1*((M3*M3)+M4)));
  T93:=(1/(M2*((EMIX*EMIX)+M4)));
  T94:=(1/(VV*M3*EMIX));
  T9:=T91*(T92+T93-T94);
```

```
  END;
FUNCTION PH9(VV,M3,M4,EMIX:REAL):REAL;
  VAR PH91,PH92:REAL;
  BEGIN
  PH91:=(4*VV*VV*VV)-(6*M3*VV*VV)+(2*M3*M3*VV);
  PH92:=(3*EMIX*VV*VV)-(4*M4*VV)+(M3*M3*EMIX);
   PH9:=PH91+PH92;
   END;

FUNCTION U4(VV,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8:REAL):REAL;
  VAR U41,U42,U43:REAL;
  BEGIN
  U41:=(-1.2864*CMIX*((2*VV)+EMIX)/(VV*VV*M2*M2));
  U42:=(1.2864*AMIX*((2*VV)+EMIX-M3)/(M2*M2*M1*M1));
  U43:=((1.2864*1.2864*BMIX*CMIX)*PH8/(VV*VV*M2*M2*M1*M1));
   U4:=U41-U42-U43;
   END;
FUNCTION U7(VV,AMIX,CMIX,M1,M2,M3,T:REAL):REAL;
  VAR U71,U72,U73,U74:REAL;
  BEGIN
  U71:=(0.008314*T*(1.2864+2.8225)/(M1*M1));
  U72:=(2*2.8225*M3*0.008314*T/(M1*M1*M1));
  U73:=(1.2864*CMIX/(VV*M2*M1));
  U74:=1.2864*((AMIX*VV)+(M3*CMIX))/(VV*M2*M1*M1);
   U7:=U71+U72-U73-U74;
   END;
FUNCTION U8(VV,T,P,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8:REAL):REAL;
  VAR U81,U82,U83,U84:REAL;
  BEGIN
  U81:=(-0.008314*T/(M1*M1));
  U82:=(2*0.008314*2.8225*BMIX*T/(M1*M1*M1));
  U83:=(AMIX*((2*VV)+EMIX-M3)/(M2*M2*M1*M1));
  U84:=(M3*CMIX*PH8/(VV*VV*VV*M2*M2*M1*M1));
   U8:=(-1/(P*P))*(U81-U82+U83+U84);
   END;
FUNCTION U12(VV,T,M3,M4,M6,M1,M2,CMIX,EMIX:REAL):REAL;
  VAR U121,U122,U123:REAL;
```

```
  BEGIN
  U121:=(1/(VV*M4*M4));
  U122:=(1/(M1*M1*((M3*M3)+M4)));
  U123:=(1/(M2*((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)));
   U12:=((M6/2)*CMIX*EMIX/(0.008314*T))*(U121+U122-U123);
   END;
FUNCTION U13(CMIX,T,M3,M4,M7,M1:REAL):REAL;
  VAR U131,U132,U133,U134:REAL;
  BEGIN
  U131:=(M3*CMIX/(0.008314*T));
  U132:=((2*1.2864*M3)+M7);
  U133:=((M3*M3)+M4)*M1;
  U134:=(((M3*M3)+M4)*U133);
   U13:=U131*U132/U134;
   END;
FUNCTION U16(VV,T,M1,M2,M3,M4,EMIX:REAL):REAL;
  VAR U161,U162,U163:REAL;
  BEGIN
  U161:=(M3/(0.008314*T));
  U162:=(1/(M1*((M3*M3)+M4)));
  U163:=(1/(((EMIX*EMIX)+M4)*M2));
   U16:=U161*(U162+U163-(1/(VV*M4)));
   END;
FUNCTION U25(VV,T,CMIX,EMIX,M1,M2,M3,M4:REAL):REAL;
  VAR U251,U252,U253,U254:REAL;
  BEGIN
  U251:=(-M3/(((M3*M3)+M4)*((M3*M3)+M4)*M1));
  U252:=(1/(((EMIX*EMIX)+M4)*M2*M2));
  U253:=(((2*EMIX)+M3)/(((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)*M2));
  U254:=(1/(M4*EMIX*VV));
   U25:=(M3*CMIX/(0.008314*T))*(U251-U252-U253+U254);
   END;
FUNCTION J3(N1,N2,VL,EMIX,AMIX,M3,T:REAL):REAL;
   VAR J31:REAL;
   BEGIN
   J31:=((1/(N2*N1))-(VL*((2*VL)+EMIX-M3)/(N2*N2*N1*N1)));
    J3:=(AMIX/(0.008314*T))*J31;
```

```
    END;
FUNCTION PH7(VL,EMIX,M3,M4:REAL):REAL;
    VAR PH71:REAL;
    BEGIN
    PH71:=(4*VL*VL*VL)+(4*VL*EMIX)+(2*VL*EMIX*EMIX);
     PH7:=PH71-(3*M3*VL*VL)-(2*M4)-(M4*EMIX);
    END;
FUNCTION S5(T,CMIX,VL,N1,N2,AMIX,M3:REAL):REAL;
    VAR S51:REAL;
    BEGIN
    S51:=((1.2864*CMIX/(VL*N2))+(AMIX*1.2864/(N1*N2))
         +(M3*1.2864*CMIX/(VL*N1*N2)));
     S5:=S51*(M3/(N1*N1*0.008314*T));
     END;
FUNCTION S11(CMIX,T,N1,N2,M3,M4,EMIX,VL:REAL):REAL;
     VAR S111:REAL;
     BEGIN
     S111:=((1/(N1*((M3*M3)+M4)))+(1/(N2*((EMIX*EMIX)+M4)))-(1/(VL*M4)));
      S11:=(1.2864*CMIX/(0.008314*T))*S111;
     END;
FUNCTION S15(M3,VL,EMIX,P,T,N1,N2:REAL):REAL;
    VAR S151:REAL;
    BEGIN
    S151:=(N2*N2*N1*N1);
     S15:=M3*((2*VL)+EMIX-M3)*((1/(P*VL))-(1/(0.008314*T)))/S151;
     END;
FUNCTION S21(AMIX,VL,M3,EMIX,CMIX,T,N1,N2:REAL):REAL;
     VAR S211:REAL;
     BEGIN
     S211:=((3*VL*VL)+(2*EMIX)+(EMIX*EMIX)-(2*M3*VL));
      S21:=(((AMIX*VL)+(M3*CMIX))/(0.008314*T*N1*N1*N2*N2*N2*N2))*S211;
      END;

FUNCTION S24(AMIX,T,M5,N1,N2,VL,M3,EMIX:REAL):REAL;
      VAR S241,S242:REAL;
      BEGIN
      S241:=(((2*VL)-M3+EMIX)/(N1*N2*N2));
```

```
    S242:=(N1/(N2*N2*N2));
     S24:=(AMIX/(0.008314*T*M5))*((-1/(N1*N2))+S241-S242);
     END;
FUNCTION T3(M1,M2,VV,EMIX,AMIX,M3,T:REAL):REAL;
   VAR T31:REAL;
   BEGIN
   T31:=((1/(M2*M1))-(VV*((2*VV)+EMIX-M3)/(M2*M2*M1*M1)));
    T3:=(AMIX/(0.008314*T))*T31;
    END;
FUNCTION PH14(VV,EMIX,M3,M4:REAL):REAL;
   VAR PH141:REAL;
   BEGIN
   PH141:=(4*VV*VV*VV)+(4*VV*EMIX)+(2*VV*EMIX*EMIX);
    PH14:=PH141-(3*M3*VV*VV)-(2*M4)-(M4*EMIX);
    END;
FUNCTION U5(T,CMIX,VV,M1,M2,AMIX,M3:REAL):REAL;
   VAR U51:REAL;
   BEGIN
   U51:=((1.2864*CMIX/(VV*M2))+(AMIX*1.2864/(M1*M2))
        +(M3*1.2864*CMIX/(VV*M1*M2)));
   U5:=U51*(M3/(M1*M1*0.008314*T));
   END;
FUNCTION U11(CMIX,T,M1,M2,M3,M4,EMIX,VV:REAL):REAL;
    VAR U111:REAL;
    BEGIN
    U111:=((1/(M1*((M3*M3)+M4)))+(1/(M2*((EMIX*EMIX)+M4)))-(1/(VV*M4)));
     U11:=(1.2864*CMIX/(0.008314*T))*U111;
    END;
FUNCTION U15(M3,VV,EMIX,P,T,M1,M2:REAL):REAL;
   VAR U151:REAL;
   BEGIN
   U151:=(M2*M2*M1*M1);
   U15:=M3*((2*VV)+EMIX-M3)*((1/(P*VV))-(1/(0.008314*T)))/U151;
    END;
FUNCTION U21(AMIX,VV,M3,EMIX,CMIX,T,M1,M2:REAL):REAL;
    VAR U211:REAL;
    BEGIN
```

```
  U211:=((3*VV*VV)+(2*EMIX)+(EMIX*EMIX)-(2*M3*VV));
  U21:=(((AMIX*VV)+(M3*CMIX))/(0.008314*T*M1*M1*M2*M2*M2*M2))*U211;
  END;

FUNCTION U24(AMIX,T,M5,M1,M2,VV,M3,EMIX:REAL):REAL;
  VAR U241,U242:REAL;
  BEGIN
  U241:=(((2*VV)-M3+EMIX)/(M1*M2*M2));
  U242:=(M1/(M2*M2*M2));
  U24:=(AMIX/(0.008314*T*M5))*((-1/(M1*M2))+U241-U242);
  END;

Function COMPRESS_FACTOR(Q1,Q2,Q3,Q4,XX1,XX2,Y1,Y2:REAL):REAL;
 VAR S,E,A,B,BEGIN_VALUE,INCRE:REAL;
  RESULT:ARRAY[1..4] OF REAL;
  INDEX,COUNTER,AGAIN:INTEGER;

  M1,M2,M3,M4,M5,M6,M7,M8,N1,N2,N8,M111,N111,NN22,MN22:REAL;
  VL,VV:REAL;
  PFV1,PFL1,FV1,NIY,FL1,NIX:REAL;
  FBV,BNIV,FCV,CNIV,FAV,ANIV,FEV,ENIV:REAL;
  FBL,BNIL,FCL,CNIL,FAL,ANIL,FEL,ENIL:REAL;
  G1,G2,G3,G4,G5,G6,G7,G8,G9,G10:REAL;
  G11,G12,G13,G14,G15,G16:REAL;
  PPV,PPL:REAL;
  H1,H2,H3,H4,H5,H6,H7,H8,H9:REAL;
  H10,H11,H12,H13,H14,H15,H16,H17,H18:REAL;

  FDIF,FN,PFLP1,PFLV1,VLP1:REAL;
  DIVL1,FVVL1,DIVL2:REAL;
  J1,J2,J4,J6,J7,J8:REAL;
  FBLV1,FCLV1,FALV1,FELV1:REAL;
  S1,S2,S3,S6,S9,S10,S14:REAL;
  S17,S18,S19,S20,S22,S23,S26:REAL;
  PH1,PH3,PH4,PH5,PH6:REAL;

  PFGP1,PFGV1,VGP1,DIVG1,FVVG1,DIVG2:REAL;
```

```
  T1,T2,T4,T6,T7,T8:REAL;
  FBGV1,FCGV1,FAGV1,FELG1:REAL;
  U1,U2,U3,U6,U9,U10,U14:REAL;
  U17,U18,U19,U20,U22,U23,U26:REAL;
  PH8,PH10,PH11,PH12,PH13,PH21,PH22:REAL;
  PH61,PH62:REAL;
  PH131,PH132:REAL;

  PH91,PH92:REAL;
  PH111,PH121,PH122:REAL;
  S141,S181,S221:REAL;
  U141,U181,U221:REAL;
  DIVI:REAL;

  JA5,JA9,PHA2,PHA6,SA4,SA7,SA8,SA12,SA13,SA16,SA25:REAL;
  TA5,TA9,PHA9,PHA13,UA4,UA7,UA8,UA12,UA13,UA16,UA25:REAL;
  JA3,PHA7,SA5,SA11,SA15,SA21,SA22,SA24:REAL;
  TA3,PHA14,UA5,UA11,UA15,UA21,UA22,UA24:REAL;

  {NUBER OF LOOP}
  Loop_No:INTEGER;

BEGIN
  BEGIN_VALUE:=0;
  COUNTER:=0;
  INCRE:=0.05;
  WRITELN;

  WHILE(BEGIN_VALUE<=1) DO
  BEGIN
    S:=1;
    E:=0.000005;
    A:=BEGIN_VALUE;
    WHILE(ABS(S)>E) DO
    BEGIN
      B:=A;
      A:=B-((B*B*B*B+Q1*B*B*B+Q2*B*B+Q3*B+Q4)/(4*B*B*B+3*Q1*B*B+2*Q2*B+Q3));
```

```
    S:=A*A*A*A+Q1*A*A*A+Q2*A*A+Q3*A+Q4;
  END;
  IF (COUNTER=0) THEN
  BEGIN
    BEGIN_VALUE:=BEGIN_VALUE+INCRE;
    IF (A>=0)AND (A<=1) THEN
    BEGIN
      COUNTER:=COUNTER+1;
      RESULT[COUNTER]:=A;
      { WRITELN('ANSWER (',COUNTER,') IS ',RESULT[COUNTER]:10:8);}

    END;
    CONTINUE;
  END;
  IF (COUNTER>0) THEN
  BEGIN
    IF COUNTER=4 THEN EXIT;
    IF (A<0) OR (A>1) THEN
    BEGIN
      BEGIN_VALUE:=BEGIN_VALUE+INCRE;
      CONTINUE;
    END;
    INDEX:=1;

    AGAIN:=0;
    WHILE(INDEX<=COUNTER) DO
    BEGIN
      IF( ABS(A-RESULT[INDEX]) < 0.01) THEN
      BEGIN
        INDEX:=INDEX+1;
        AGAIN:=1;
        CONTINUE;
      END;
      INDEX:=INDEX+1;
    END;
    IF(AGAIN=0) THEN
    BEGIN
```

```
        COUNTER:=COUNTER+1;
        RESULT[COUNTER]:=B;

      END;
    END;
    BEGIN_VALUE:=BEGIN_VALUE+INCRE;
  END;
  IF (COUNTER=0) THEN
  BEGIN
    WRITELN;
    WRITELN('NO ANSWER');
  END;

  IF (COUNTER<2) OR (COUNTER>4) THEN EXIT;

  ZL:=RESULT[1];
  IF (COUNTER=2) THEN
    ZV:=RESULT[2]
  ELSE IF (COUNTER=3) THEN
    ZV:=RESULT[3]
  ELSE
    ZV:=RESULT[4];

{   WRITELN(' ZL = ',ZL:10:8,' ZV = ',ZV:10:8);}


{PROGRAM CALCULATION PARTIAL FUGACITY COEFFICIENT
 FOR VAPOR &LIQUID PHASE IN BINARY MIXTURE}

  PFV1:=5;
  PFL1:=3;

  P:=((XX1*P1sat)+(XX2*P2sat))/2;
  ANSWER:=P;

  WHILE (Abs((XX1*PFL1)-(Y1*PFV1))>0.0001) DO
  Loop_No:=0;
```

```
BEGIN
  VL:=(ZL*0.008314*T/P);
  VV:=(ZV*0.008314*T/P);
  M1:=VV-(1.2864*BMIX);
  M2:=VV+EMIX;
  M3:=1.2864*BMIX;
  M4:=1.2864*BMIX*EMIX;
  M5:=(1.2864*BMIX)+EMIX;
  M6:=3.31*BMIX;
  M7:=1.2864*EMIX;
  M8:=(1.2864*BMIX)-VV;
  N1:=VL-(1.2864*BMIX);
  N2:=VL+EMIX;
  N8:=(1.2864*BMIX)-VL;
  M111:=M1*M1*M1;
  N111:=N1*N1*N1;
  MN22:=M1*M1*N2*N2;
  NN22:=N1*N1*N2*N2;
  PPV:=(0.008314*T/M1)+(BMIX*0.0235*T/(M1*M1))-
  (((AMIX*VV)+(1.2864*BMIX*CMIX))/(VV*M2*M1));
  PPL:=(0.008314*T/N1)+(BMIX*0.0235*T/(N1*N1))-
  (((AMIX*VL)+(1.2864*BMIX*CMIX))/(VL*N2*N1));

  {VAPOR PHASE}

  G1:=(1.2864/M1) + (2.8225/M1) + (3.631*BMIX/(M1*M1));
  G2:=(((154.727*AMIX)/(T*M5))*((1/M1)+((Ln(M1/M2))/M5)));

G3:=(((1.2864*CMIX)/(0.008314*T))*((Ln(M1)/((M3*M3)+M4))+(Ln(M2)/((EMIX*EMIX)+M4))-(Ln(VV)/
M4)));
  G4:=((199.04*BMIX*CMIX*EMIX/T)*((Ln(VV)/(M4*M4))-(1/(M1*((M3*M3)+M4)))-
  (Ln(M2)/(((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)))));
  G5:=(((1.2864*BMIX*CMIX)/(0.008314*T))*
    (Ln(M1)*(M6+M7)/(((M3*M3)+M4)*((M3*M3)+M4))));
  H1:=((VV/(M1))*((4.1089/M1)+(7.2617*BMIX/(M1*M1))));
  H2:=((VV/(0.008314*T*M1))*((1.2864*CMIX/(VV*M2))+(1.2864*AMIX/(M2*M1))+
```

```
    (1.6548*BMIX*CMIX/(VV*M1*M2))));
    H3:=(1/PPV);
    H4:=(0.0342*T/(M1*M1));
    H5:=(0.0604*T*BMIX/(M111));
    H6:=(1.2864*CMIX/(VV*M1*M2));
    H7:=(1.2864*((AMIX*VV)+(1.2864*BMIX*CMIX))/(VV*M2*M1*M1));

    FBV:=H1-H2-(H3*(H4+H5-H6-H7))+G1-G2+(G3+(G4-G5));
    BNIV:=((B1-B2)*Y2);

FCV:=((-1.2864*BMIX)/(0.008314*T*M2*M1))+(1.2864*BMIX/(VV*M2*M1*PPV))+((M3/(0.008314*T))
*
    ((Ln(M1)/((M3*M3)+M4))+(Ln(M2)/((EMIX*EMIX)+M4))-(Ln(VV)/M4)));
    CNIV:=((2*C1*Y1*Y2)+(2*SQRT(C1)*SQRT(C2)*((Y2*Y2)-(Y1*Y2)))-(2*C2*Y2*Y2));
    FAV:=(-VV/(0.008314*T*M2*M1))+(VV/(VV*M2*M1*PPV))+(Ln(M1/M2))/(0.008314*T*M5);
    ANIV:=((2*A1*Y1*Y2)+(2*SQRT(A1)*SQRT(A2)*(1-Kij)*((Y2*Y2)-(Y1*Y2)))-(2*A2*Y2*Y2));

    G11:=((AMIX/(0.008314*T*M5))*((M8/(M1*M2))-(Ln(M1/M2)/M5)));
    G12:=((-1.2864*BMIX*Ln(M1))/(((M3*M3)+M4)*((M3*M3)+M4)));
    G13:=(((2*EMIX)+M3)*Ln(M2)/(((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)));
    H15:=(((AMIX*VV)+(1.2864*BMIX*CMIX))/(0.008314*T*M1*M2*M2));
    H16:=(((AMIX*VV)+(1.2864*BMIX*CMIX))/(PPV*VV*M1*M2*M2));

FEV:=H15-H16+G11+((154.727*BMIX*CMIX/T)*(G12+(1/(M2*((EMIX*EMIX)+M4)))-G13+(Ln(VV)/(M3
*EMIX*EMIX))));
    ENIV:=((E1-E2)*Y2);
    {LIQUID PHASE}


    G6:=(1.2864/N1) + (2.8225/N1) + (3.631*BMIX/(N1*N1));
    G7:=(((154.727*AMIX)/(T*M5))*((1/N1)+((Ln(N1/N2))/M5)));

G8:=(((1.2864*CMIX)/(0.008314*T))*((Ln(N1)/((M3*M3)+M4))+(Ln(N2)/((EMIX*EMIX)+M4))-(Ln(VV)/M
4)));
    G9:=((199.04*BMIX*CMIX*EMIX/T)*((Ln(VV)/(M4*M4))-(1/(N1*((M3*M3)+M4)))-
    (Ln(N2)/(((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)))));
    G10:=(((1.2864*BMIX*CMIX)/(0.008314*T))*
```

```
    (Ln(N1)*(M6+M7)/(((M3*M3)+M4)*((M3*M3)+M4))));
  H8:=((VL/(N1))*((4.1089/N1)+(7.2617*BMIX/(N1*N1))));
  H9:=((VL/(0.008314*T*N1))*((1.2864*CMIX/(VL*N2))+(1.2864*AMIX/(N2*N1))+
    (1.6548*BMIX*CMIX/(VL*N1*N2))));
  H10:=(1/PPL);
  H11:=(0.0342*T/(N1*N1));
  H12:=(0.0604*T*BMIX/(N111));
  H13:=(1.2864*CMIX/(VL*N1*N2));
  H14:=(1.2864*((AMIX*VL)+(1.2864*BMIX*CMIX))/(VL*N2*N1*N1));
  FBL:=H8-H9-(H10*(H11+H12-H13-H14))+G6-G7+(G8+(G9-G10));
  BNIL:=((B1-B2)*XX2);
  FCL:=((-1.2864*BMIX)/(0.008314*T*N2*N1))+(1.2864*BMIX/(VL*N2*N1*PPL))+
  ((M3/(0.008314*T))*((Ln(N1)/((M3*M3)+M4))+(Ln(N2)/((EMIX*EMIX)+M4))-
  (Ln(VL)/M4)));
  CNIL:=((2*C1*XX1*XX2)+(2*SQRT(C1)*SQRT(C2)*((XX2*XX2)-(XX1*XX2)))-(2*C2*
  XX2*XX2));
  FAL:=(-VL/(0.008314*T*N2*N1))+(VL/(VL*N2*N1*PPL))+(Ln(N1/N2))/(0.008314*T*M5);
  ANIL:=((2*A1*XX1*XX2)+(2*SQRT(A1)*SQRT(A2)*(1-Kij)*((XX2*XX2)-(XX1*XX2)))-(2*A2*
  XX2*XX2));
  G14:=((AMIX/(0.008314*T*M5))*((N8/(N1*N2))-(Ln(N1/N2)/M5)));
  G15:=((-1.2864*BMIX*Ln(N1))/(((M3*M3)+M4)*((M3*M3)+M4)));
  G16:=(((2*EMIX)+M3)*Ln(N2)/(((EMIX*EMIX)+M4)*((EMIX*EMIX)+M4)));
  H17:=(((AMIX*VL)+(1.2864*BMIX*CMIX))/(0.008314*T*N1*N2*N2));
  H18:=(((AMIX*VL)+(1.2864*BMIX*CMIX))/(PPL*VL*N1*N2*N2));

FEL:=H17-H18+G14+((154.727*BMIX*CMIX/T)*(G15+(1/(N2*((EMIX*EMIX)+M4)))-G16+(Ln(VV)/(M3
*EMIX*EMIX))));
  ENIL:=((E1-E2)*XX2);
  {DIFF N(Ln FUGACITY) WITH ni When nj,t,p constant}
  NIY:=(FBV*BNIV)+(FCV*CNIV)+(FAV*ANIV)+(FEV*ENIV);
  NIX:=(FBL*BNIL)+(FCL*CNIL)+(FAL*ANIL)+(FEL*ENIL);
  FV1:=(ZV-1-Ln(ZV)+Ln(VV/M1)+(2.8225*BMIX/M1)+
    ((AMIX/(0.008314*T*M5))*(Ln(M1/M2)))+
    ((154.727*BMIX*CMIX/T)*((Ln(M1)/((M3*M3)+M4))
    +(Ln(M2)/((EMIX*EMIX)+M4))-(Ln(VV)/M4))));
  FL1:=(ZL-1-Ln(ZL)+Ln(VL/N1)+(2.8225*BMIX/N1)+
    ((AMIX/(0.008314*T*M5))*(Ln(N1/N2)))+
```

```
   ((154.727*BMIX*CMIX/T)*((Ln(N1)/((M3*M3)+M4))
   +(Ln(N2)/((EMIX*EMIX)+M4))-(Ln(VL)/M4))));
PFV1:=EXP(FV1+NIY);
PFL1:=EXP(FL1+NIX);

{THIS PART TO SET INITIAL PRESSURE}
 {PARAMETER FOR LIQUID PHASE}
 {GROUP ONE}
J1:=-(M3/(N1*N1));
J2:=(2.8225*BMIX)*((1/(N1*N1))-(2*VL/(N111)));

J4:=(M3*CMIX/(0.008314*T))*(-1)*((2*VL)-M3+EMIX)/(NN22);

J6:=M3/(VL*N1);
J7:=(2.8225*BMIX)/(N1*N1);
J8:=AMIX/(0.008314*T*N1*N2);


{GROUP TWO}

PH1:=((3*VL*VL)+(2*EMIX*VL)-(2*M3*VL)-M4);


PH3:=-2*0.008314*T*(2.8225+1.2864)/(N111);
PH4:=-6*2.8225*M3*0.008314*T/(N111*N1);
PH5:=1.2864*CMIX*PH1/(VL*VL*NN22);


{GROUP THREE}
S1:=(VL/(N1*N1*N1))*(-(2.8225+1.2864)-(4*2.8225*1.2864*BMIX/N1));
S2:=(M3/(N1*N1*N1))*((2.8225+1.2864)+(2*2.8225*1.2864*BMIX/N1));
S3:=(VL/(0.008314*T*N1));
```

```
PHA2:=PH2(VL,M3,M4,EMIX);
PH61:=((VL*N2*N1*N1*AMIX)-(((AMIX*VL)+M4)*PHA2));
PH62:=(VL*VL*NN22*N1*N1);
 PH6:=1.2864*PH61/PH62;

S6:=PH3+PH4+PH5-PH6;




S9:=(-1.2864/(N1*N1))-(2.8225/(N1*N1))-(2*M3*2.8225/(N111));
S10:=(AMIX*1.2864/(0.008314*T*M5))*((-1/(N1*N1))+(1/(N1*N2)));




SA8:=S8(VL,T,P,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1);
S141:=((SA8/(-1/(P*P)))/(VL*P*P));
S14:=(M3/(N2*N1))*((-1/(P*VL*VL))-S141);




S17:=((VL*((2*VL)+EMIX-M3))-(N1*N2))
   /(0.008314*T*NN22);
S181:=(P*P*NN22);
SA8:=S8(VL,T,P,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1);
S18:=((((2*VL)+EMIX-M3)*P)+(N1*N2*(SA8/(-1/(P*P)))))/S181;
S19:=1/(0.008314*T*N1*N2);
S20:=AMIX/(0.008314*T*N1*N2*N2);
PHA7:=PH7(VL,EMIX,M3,M4);
S221:=((((AMIX*VL)+(M3*CMIX))/(VL*VL*NN22*N2*N2))*PHA7);
 S22:=(AMIX/(VL*N1*N2*N2))-S221;
```

```
SA8:=S8(VL,T,P,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1);
S23:=-SA8*((AMIX*VL)+(M3*CMIX))/(VL*N1*N2*N2);

{EQUATIONS TO  CALCULATE FOR LIQUID PHASE}
 SA4:=S4(VL,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1);
 SA5:=S5(T,CMIX,VL,N1,N2,AMIX,M3);
 SA7:=S7(VL,AMIX,CMIX,N1,N2,M3,T);
 SA8:=S8(VL,T,P,AMIX,BMIX,CMIX,EMIX,N1,N2,M3,PH1);
 SA11:=S11(CMIX,T,N1,N2,M3,M4,EMIX,VL);
SA12:=S12(VL,T,M3,M4,M6,N1,N2,CMIX,EMIX);
 SA13:=S13(CMIX,T,M3,M4,M7,N1);
FBLV1:=S1-S2-(S3*SA4)+SA5-(S6/P)-(SA7*SA8)+S9-S10+SA11+SA12-SA13;
 SA15:=S15(M3,VL,EMIX,P,T,N1,N2);
 SA16:=S16(VL,T,N1,N2,M3,M4,EMIX);
FCLV1:=S14-SA15+SA16;
FALV1:=S17-S18+S19;
 SA25:=S25(VL,T,CMIX,EMIX,N1,N2,M3,M4);
 SA21:=S21(AMIX,VL,M3,EMIX,CMIX,T,N1,N2);
 PHA7:=PH7(VL,EMIX,M3,M4);

 SA24:=S24(AMIX,T,M5,N1,N2,VL,M3,EMIX);
FELV1:=S20-SA21-(S22/P)+S23+SA24+SA25;
DIVL2:=(BNIL*FBLV1)+(CNIL*FCLV1)+(ANIL*FALV1)+(ENIL*FELV1);
 JA3:=J3(N1,N2,VL,EMIX,AMIX,M3,T);
 JA5:=J5(BMIX,AMIX,EMIX,N1,N2,M3,T,VL);
 JA9:=J9(CMIX,EMIX,M3,M4,N1,N2,T,VL);
FVVL1:=J1+J2-JA3-J4-(JA5/P)-(1/VL)-J6-J7+J8+JA9;
DIVL1:=FVVL1+DIVL2;
PFLV1:=PFL1*DIVL1;
VLP1:=-(ZL*0.008314*T/(P*P));
PFLP1:=PFLV1*VLP1;
```

```
{PARAMETER FOR VAPOR PHASE}
 {GROUP ONE}
T1:=-(M3/(M1*M1));
T2:=(2.8225*BMIX)*((1/(M1*M1))-(2*VV/(M111)));
T4:=(M3*CMIX/(0.008314*T))*(-1)*((2*VV)-M3+EMIX)/(M2*M2*M1*M1);
T6:=M3/(VV*M1);
T7:=(2.8225*BMIX)/(M1*M1);
T8:=AMIX/(0.008314*T*M1*M2);
 {GROUP TWO}

PH8:=((3*VV*VV)+(2*EMIX*VV)-(2*M3*VV)-M4);
PH10:=-2*0.008314*T*(2.8225+1.2864)/(M111);
PH111:=(M1*M111);
PH11:=-6*2.8225*M3*0.008314*T/PH111;

PH121:=M2*M2*M1*M1;
PH122:=(VV*VV*PH121);
PH12:=1.2864*CMIX*PH8/PH122;

{GROUP THREE}
U1:=(VV/(M111))*(-(2.8225+1.2864)-(4*2.8225*1.2864*BMIX/M1));
U2:=(M3/(M111))*((2.8225+1.2864)+(2*2.8225*1.2864*BMIX/M1));
U3:=(VV/(0.008314*T*M1));
PHA9:=PH9(VV,M3,M4,EMIX);
PH131:=((VV*M2*M1*M1*AMIX)-(((AMIX*VV)+M4)*PHA9));
PH132:=(VV*VV*M2*M2*M1*M111);
PH13:=1.2864*PH131/PH132;

U6:=PH10+PH11+PH12-PH13;
U9:=(-1.2864/(M1*M1))-(2.8225/(M1*M1))-(2*M3*2.8225/(M111));
U10:=(AMIX*1.2864/(0.008314*T*M5))*((-1/(M1*M1))+(1/(M1*M2)));
UA8:=U8(VV,T,P,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8);
U141:=((UA8/(-1/(P*P)))/(VV*P*P));
U14:=(M3/(M2*M1))*((-1/(P*VV*VV))-U141);
U17:=((VV*((2*VV)+EMIX-M3))-(M1*M2))
   /(0.008314*T*M2*M2*M1*M1);
```

```
U181:=(P*P*M2*M2*M1*M1);
UA8:=U8(VV,T,P,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8);
U18:=((((2*VV)+EMIX-M3)*P)+(M1*M2*(UA8/(-1/(P*P)))))/U181;
U19:=1/(0.008314*T*M1*M2);
U20:=AMIX/(0.008314*T*M1*M2*M2);
PHA14:=PH14(VV,EMIX,M3,M4);
U221:=((((AMIX*VV)+(M3*CMIX))/(VV*VV*M1*M1*M2*M2*M2*M2))*PHA14);
U22:=(AMIX/(VV*M1*M2*M2))-U221;
UA8:=U8(VV,T,P,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8);
U23:=-UA8*((AMIX*VV)+(M3*CMIX))/(VV*M1*M2*M2);

{EQUATION TO CALCULATE FOR VAPOR PHASE}
UA4:=U4(VV,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8);
UA5:=U5(T,CMIX,VV,M1,M2,AMIX,M3);
UA7:=U7(VV,AMIX,CMIX,M1,M2,M3,T);
UA8:=U8(VV,T,P,AMIX,BMIX,CMIX,EMIX,M1,M2,M3,PH8);
UA11:=U11(CMIX,T,M1,M2,M3,M4,EMIX,VV);
UA12:=U12(VV,T,M3,M4,M6,M1,M2,CMIX,EMIX);
UA13:=U13(CMIX,T,M3,M4,M7,M1);
FBGV1:=U1-U2-(U3*UA4)+UA5-(U6/P)-(UA7*UA8)+U9-U10+UA11+UA12-UA13;
UA15:=U15(M3,VV,EMIX,P,T,M1,M2);
UA16:=U16(VV,T,M1,M2,M3,M4,EMIX);

FCGV1:=U14-UA15+UA16;
FAGV1:=U17-U18+U19;
UA25:=U25(VV,T,CMIX,EMIX,M1,M2,M3,M4);
UA21:=U21(AMIX,VV,M3,EMIX,CMIX,T,M1,M2);
PHA14:=PH14(VV,EMIX,M3,M4);

UA24:=U24(AMIX,T,M5,M1,M2,VV,M3,EMIX);
FELG1:=U20-UA21-(U22/P)+U23+UA24+UA25;
DIVG2:=(BNIV*FBGV1)+(CNIV*FCGV1)+(ANIV*FAGV1)+(ENIV*FELG1);
TA3:=T3(M1,M2,VV,EMIX,AMIX,M3,T);
TA5:=T5(BMIX,AMIX,EMIX,M1,M2,M3,T,VV);
TA9:=T9(CMIX,EMIX,M3,M4,M1,M2,T,VV);

FVVG1:=T1+T2-TA3-T4-(TA5/P)-(1/VV)-T6-T7+T8+TA9;
```

```
    DIVG1:=FVVG1+DIVG2;
   PFGV1:=PFV1*DIVG1;
    VGP1:=-(ZV*0.008314*T/(P*P));
   PFGP1:=PFGV1*VGP1;

    {FINAL PROPOSE EQUATION}
    DIVI:=(Abs((XX1*PFL1)-(Y1*PFV1)));
   FDIF:=(XX1*PFLP1)-(Y1*PFGP1);
     FN:=(XX1*PFL1)-(Y1*PFV1);
      P:=P-(FN/FDIF);

    IF (P>Pex) THEN
    begin
       P:=ANSWER;
       Loop_No:=30;
    end
    else if(P < 0) THEN
    begin
      Loop_No:=30;
    end
    else IF (P > ANSWER ) THEN
    begin
      ANSWER:=P;
    end;

    Loop_No:=Loop_No+1;

        END;
  WRITELN('PCAL = ',ANSWER:10:8,' MPa');
  writeln('No. of loop = ',Loop_No);
  writeln('KIJ = ',KIJ:10:8);


{   WRITELN('DIVIATION = ',DIVI:10:8);}

END;
  FUNCTION ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P:REAL):REAL;
```

```
BEGIN

Pex:=P;
Bc1:=0.165 * Vc1;
P1:=( exp((-0.03125 * ln(T/Tc1)) -(0.0054*(ln(T/Tc1)*ln(T/Tc1)))));
B1:=Bc1 * P1 * P1 * P1;

Bc2:=0.165 * Vc2;
P2:=( exp((-0.03125 * ln(T/Tc2)) -(0.0054*(ln(T/Tc2)*ln(T/Tc2)))));
B2:=Bc2 * P2 * P2 * P2;

BMIX:=(Y1 * B1) + (Y2 * B2);
ER1:=0.63189 * (1 - (0.81660 * W1) + (3.25246 * W1 * W1));

E1:=ER1/DC1;
ER2:=0.63189 * (1 - (0.81660 * W2) + (3.25246 * W2 * W2));
E2:=ER2/(DC2);
EMIX:=(Y1 * E1) + (Y2 * E2);

{
  Calculate value a of polar component!
}

IF (StrLComp(kind1,'POLAR',5)=0) THEN
BEGIN
  TR1:=T/Tc1;
  ReDipole1:=(0.3976 * DipoleMoment1) / (Sqrt(0.008314 * Tc1 * Vc1));
  IF (TR1 <=1) THEN
  BEGIN
    X2:=0.14988+(0.97848 * W1)+(-0.01390*ReDipole1)+(0.02928 * ReDipole1 * ReDipole1);
    X3:=-0.32379+(1.84591*W1)+(0.39338*ReDipole1)+(-0.25483*ReDipole1*ReDipole1);
    X4:=(0.14833)+(-3.46693 * W1)+(-0.39170 * ReDipole1) + (-0.01597 * ReDipole1 *
ReDipole1);
    ALPHA1:=(1+(X2*(1-(Sqrt(TR1)))+X3*(1-Sqrt(TR1)))*(1-(Sqrt(TR1))))+(X4*(1-Sqrt(TR1))*(1-
Sqrt(TR1))*(1-Sqrt(TR1)));
    ALPHATR:=ALPHA1 * ALPHA1;
  END
```

```
    ELSE
    BEGIN
      X2:=0.14988+(0.97848 * W1)+(-0.01390*ReDipole1)+(0.02928 * ReDipole1 * ReDipole1);
      X5:=0.11048+(0.57743*W1)+(0.41218*ReDipole1)+(-0.10676*ReDipole1*ReDipole1);
      X6:=0.02581+(-0.027*W1)+(0.38327*ReDipole1)+(-0.09008*ReDipole1*ReDipole1);

ALPHA2:=(1+(X2*(1-(Sqrt(TR1)))+X5*(1-Sqrt(TR1)))*(1-(Sqrt(TR1))))+(X6*(1-Sqrt(TR1))*(1-Sqrt(TR1))*
(1-Sqrt(TR1)));
      ALPHATR:=ALPHA2 * ALPHA2;
    END;

ar1:=1.84713*(1-(0.05218*W1)+(1.06446*W1*W1)-(0.0273*ReDipole1)+(0.02048*ReDipole1*Re
Dipole1));
    ac1:=(ar1*8.314*(1/1000)*Tc1)/(DC1);
    a1:=ac1*ALPHATR;

    {
      Calculate value c of polar component1
    }

cr1:=1.78336*(1+(-1.29690*W1)+(2.78945*W1*W1)+(0.07*ReDipole1)+(0.01188*ReDipole1*ReD
ipole1));
    cc1:=(cr1*8.314*(1/1000)*Tc1)/Dc1;
    X7:=(-0.77357)+(-1.45342*W1)-(0.04725 * ReDipole1) - (0.09669 * ReDipole1 * ReDipole1 );
    tempdep1:=(1+ (X7 * (1 - Sqrt(TR1))));
    tempdep11:=tempdep1*tempdep1;
    c1:=cc1*tempdep11;
  END
  {
    Calculate value a of nonpolar component1
  }
  ELSE
  BEGIN
    TR1:=T/Tc1;
    IF(TR1<=1) THEN
    BEGIN
      X2:=0.14988+(0.97848*W1);
```

```
    X3:=(-0.32379)+(1.84591*W1);
    X4:=0.14833+((-3.46693)*W1);
    ALPHA1:=(1+(X2*(1-Sqrt(TR1))))+(X3*(1-(Sqrt(TR1)))*(1-(Sqrt(TR1)))
        +(X4*(1-SQRT(TR1)) * (1-Sqrt(TR1)) * (1-Sqrt(TR1))));
    ALPHATR:=ALPHA1*ALPHA1;
  END
  ELSE
  BEGIN
    X2:=0.14988+(0.97848*W1);
    X5:=0.11048+(0.57743*W1);
    X6:=0.02581+(-0.027*W1);
    ALPHA2:=(1+(X2*(1-Sqrt(TR1))))+(X5*(1-(Sqrt(TR1)))*(1-(Sqrt(TR1)))
        +(X6*(1-SQRT(TR1)) * (1-Sqrt(TR1)) * (1-Sqrt(TR1))));
    ALPHATR:=ALPHA2*ALPHA2;
  END;
  ar1:=1.84713*(1-(0.05218*W1))+(1.06446*W1*W1);
  ac1:=(ar1*8.314*(1/1000)*Tc1)/(DC1);
  a1:=ac1*ALPHATR;
  {
     Calculate value c of nonpolar component1
  }
  cr1:=1.78336*(1+(-1.29690*W1)+(2.78945*W1*W1));
  cc1:=(cr1*8.314*(1/1000)*Tc1)/Dc1;
  X7:=(-0.77357)+(-1.45342*W1);
  tempdep1:=(1+ (X7 * (1 - Sqrt(TR1))));
  tempdep11:=tempdep1*tempdep1;
  c1:=cc1*tempdep11;
END;
{
  Calculate value a of polar component2
}
iF (StrLComp(kind2,'POLAR',5)=0) THEN
BEGIN
  TR2:=T/Tc2;
  ReDipole2:=(0.3976 * DipoleMoment2) / (Sqrt(0.008314 * Tc2 * Vc2));
  IF (TR2 <=1) THEN
  BEGIN
```

```
        Z2:=0.14988+(0.97848 * W2)+ (-0.01390*ReDipole2)+(0.02928 * ReDipole2 *
 ReDipole2);
        Z3:=-0.32379+(1.84591*W2)+(0.39338*ReDipole2)+(-0.25483*ReDipole2*ReDipole2);
        Z4:=(0.14833)+(-3.46693 * W2)+(-0.39170 * ReDipole2) + (-0.01597 * ReDipole2 *
 ReDipole2);
        {there are error here}

ALPHA3:=(1+(Z2*(1-(Sqrt(TR2)))+Z3*(1-Sqrt(TR2)))*(1-(Sqrt(TR2))))+(Z4*(1-Sqrt(TR2))*(1-Sqrt(TR2))*
(1-Sqrt(TR2)));
        ALPHATR1:=ALPHA3 * ALPHA3;
      END
      ELSE
      BEGIN
        Z2:=0.14988+(0.97848 * W2)+(-0.01390*ReDipole2)+(0.02928 * ReDipole2 * ReDipole2);
        Z5:=0.11048+(0.57743*W2)+(0.41218*ReDipole2)+(-0.10676*ReDipole2*ReDipole2);
        Z6:=0.02581+(-0.027*W2)+(0.38327*ReDipole2)+(-0.09008*ReDipole2*ReDipole2);
        ALPHA4:=(1+(Z2*(1-(Sqrt(TR2)))+Z5*(1-Sqrt(TR2)))*(1-(Sqrt(TR2))))
             +(Z6 * (1 - Sqrt(TR2)) * (1- Sqrt(TR2)) * (1-Sqrt(TR2)));
        ALPHATR1:=ALPHA4 * ALPHA4;
      END;

ar2:=1.84713*(1-(0.05218*W2)+(1.06446*W2*W2)-(0.0273*ReDipole2)+(0.02048*ReDipole2*Re
Dipole2));
      ac2:=(ar2*8.314*(1/1000)*Tc2)/DC2;
      a2:=ac2*ALPHATR1;

      {
          Calculate value c of polar component2
      }

cr2:=1.78336*(1+(-1.29690*W2)+(2.78945*W2*W2)+(0.07*ReDipole2)+(0.01188*ReDipole2*ReD
ipole2));
      cc2:=(cr2*8.314*(1/1000)*Tc2)/Dc2;
      Z7:=(-0.77357)+(-1.453428*W2)-(0.04725 * ReDipole2) - (0.09669 * ReDipole2 * ReDipole2
);
      tempdep2:=(1+ (Z7 * (1 - Sqrt(TR2))));
      tempdep22:=tempdep2*tempdep2;
```

```
  c2:=cc2*tempdep22;
END
{
  Calculate value a of nonpolar component2
}
ELSE
BEGIN
  TR2:=T/Tc2;
  IF(TR2<=1) THEN
  BEGIN
    Z2:=0.14988+(0.97848*W2);
    Z3:=(-0.32379)+(1.84591*W2);
    Z4:=0.14833+((-3.46693)*W2);
    ALPHA3:=(1+(Z2*(1-Sqrt(TR2))))+(Z3*(1-(Sqrt(TR2)))*(1-(Sqrt(TR2)))
        +(Z4*(1-SQRT(TR2)) * (1-Sqrt(TR2)) * (1-Sqrt(TR2))));
    ALPHATR1:=ALPHA3*ALPHA3;
  END
  ELSE
  BEGIN
    Z2:=0.14988+(0.97848*W2);
    Z5:=0.11048+(0.57743*W2);
    Z6:=0.02581+(-0.027*W2);
    ALPHA4:=(1+(Z2*(1-Sqrt(TR2))))+(Z5*(1-(Sqrt(TR2)))*(1-(Sqrt(TR2)))
        +(Z6*(1-SQRT(TR2)) * (1-Sqrt(TR2)) * (1-Sqrt(TR2))));
    ALPHATR1:=ALPHA4*ALPHA4;
  END;
  ar2:=1.84713*(1-(0.05218*W2))+(1.06446*W2*W2);
  ac2:=(ar2*8.314*(1/1000)*Tc2)/DC2;
  a2:=ac2*ALPHATR1;
  {
    Calculate value c of nonpolar component2
  }
  cr2:=1.78336*(1+(-1.29690*W2)+(2.78945*W2*W2));
  cc2:=(cr2*8.314*(1/1000)*Tc2)/Dc2;
  Z7:=(-0.77357)+(-1.45342*W2);
  tempdep2:=(1+ (Z7 * (1 - Sqrt(TR2))));
  tempdep22:=tempdep2*tempdep2;
```

```
    c2:=cc2*tempdep22;
  END;
  {OLD FASION


  aMIX:=(Y1*Y1*a1)+(2*Y2*Y2*(Sqrt(a1*a2)))+(Y2*Y2*A2);
  cMIX:=(Y1*Y1*c1)+(2*Y1*Y2*Sqrt(c1*c2))+(Y2*Y2*c2);
  }
  aMIX:=(Y1*Y1*a1)+(2*Y1*Y2*(Sqrt(a1*a2))*(1-Kij))+(Y2*Y2*a2);
  cMIX:=(Y1*Y1*c1)+(2*Y1*Y2*(Sqrt(c1*c2))+(Y2*Y2*c2));

  {
  O1:=(((P*P*EMIX*BMIX*1.2864)-(P*P*EMIX*BMIX*2.8225))/(0.008314*0.008314*T*T));
  O3:=0.008314*0.008314*0.008314*T*T*T;

O2:=(((P*P)/(0.008314*0.008314*T*T))*((1.2864*1.2864*BMIX*BMIX)-(2*1.2864*BMIX*EMIX)))+((A
MIX*P)/(0.008314*0.008314*T*T));

Q4:=(-CMIX*(1.2864)*(1.2864)*BMIX*BMIX*P*P*P)/(0.008314*0.008314*0.008314*0.008314*T*T*
T*T);

Q3:=(((P*P*P*EMIX*1.2864*1.2864*BMIX*BMIX)+(1.2864*BMIX*CMIX*P*P)-(1.2864*BMIX*AMIX*
P*P))/O3)+O1;
  Q2:=((P/(0.008314*T))*((BMIX*1.2864)-(BMIX*2.8225)-EMIX))+O2;
  Q1:=((P/(0.008314*T))*((-2*1.2864*BMIX)+EMIX))-1;
  COMPRESS_FACTOR(Q1,Q2,Q3,Q4,XX1,XX2,Y1,Y2);
END;


  BEGIN {Main}
   clrscr;
   Assign (Input,'C:\TP\data\datafile.dat');
   Reset(Input);
   {Temp file}
   Assign (output,'c:\tp\data\temp.dat');
   Rewrite(output);
   Write('Enter name of the substance1: ');Readln(Fname1);
```

```
Found1:=0;
WHILE(Found1=0) DO
BEGIN
   WHILE NOT EOF(Input) DO
   BEGIN
      Readln(Input,Fname3);
      Len:=StrLen(Fname1);
      Po:=StrLComp(StrLower(Fname1),StrLower(Fname3),Len);
      If (Po=0) then
      BEGIN
            Found1:=1;
            Break;
      END;
   END;
   IF (Found1=0) THEN
   BEGIN
      Write('Enter New Substance1 again: ');Readln(Fname1);
      Reset(Input);
   END;
END;

Reset(Input);
Write('Enter name of the substance2: ');Readln(Fname2);
Found2:=0;
WHILE(Found2=0) Do
BEGIN
   WHILE NOT EOF(Input) DO
   BEGIN
      Readln(Input,Fname4);
      Len:=StrLen(Fname2);
      Po:=StrLComp(StrLower(Fname4),StrLower(Fname2),Len);
      If (Po=0) then
      BEGIN
            Found2:=1;
            Break;
      END;
   END;
```

```
    IF(Found2=0)THEN
    BEGIN
       Write('Enter New Substance2 again: ');Readln(Fname2);
       Reset(Input);
    END;
END;

Reset(Input);
readln(Input);
readln(Input);
WHILE NOT EOF(Input) DO
BEGIN
   Readln(Input,substance1,kind1,Tc1,Pc1,Dc1,DipoleMoment1,Vc1,W1);
   Len:=StrLen(Fname1);

   Po:=StrLComp(StrLower(substance1),StrLower(Fname1),Len);
   If (Po=0) then
      Break;
END;

Reset(Input);
Readln(Input);
Readln(Input);
WHILE NOT EOF(Input) DO
BEGIN
   readln(Input,substance2,kind2,Tc2,Pc2,Dc2,DipoleMoment2,Vc2,W2);
   Len:=StrLen(Fname2);
   Po:=StrLComp(StrLower(substance2),StrLower(Fname2),Len);
   If (Po=0) then
      Break;
END;
write('Enter Temperature(K) : ');readln(T);
Tex:=T;
Write('Enter Pressure (MPa) : ');readln(P);
Pex:=P;
write('Enter XX1 : ');readln(XX1);
write('Enter XX2 : ');readln(XX2);
```

```
write('Enter Y1 : ');readln(Y1);
write('Enter Y2 : ');readln(Y2);
write('Enter P1sat: ');readln(P1sat);
write('Enter P2sat: ');readln(P2sat);
{
ROOTofQEOS(XX1,XX2,Y1,Y2,0,T,P);
}
write('SELECT Pconst. OR Tconst. (T,P): ');
readln(steady);

IF (steady='P') OR (steady='p') THEN
BEGIN

 {write('Please enter no.of Temperature data points:  ');
 readln(NUMOFT);
 write('Please enter upper Kij value  ');
 readln(DU);
 write('Please enter lower Kij value  ');
 readln(DL); }

 COUNTIT:=1;
 WHILE(COUNTIT<=NUMOFT)DO
 BEGIN
   write('please enter Tgroup[',COUNTIT,']:  ');
   readln(Tgroup[COUNTIT]);
   COUNTIT:=COUNTIT+1;
 END;

 COUNTIT:=1;
 WHILE(COUNTIT<=NUMOFT)DO
 BEGIN
   write('please enter XX1[',COUNTIT,']:  ');
   readln(XX1group[COUNTIT]);
   COUNTIT:=COUNTIT+1;
 END;

 COUNTIT:=1;
```

```
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter XX2group[',COUNTIT,']: ');
  readln(XX2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter Y1group[',COUNTIT,']: ');
  readln(Y1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter Y2group[',COUNTIT,']: ');
  readln(Y2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;}


 EPS:=0.000001;
COUNTIT:=1;


 WHILE (1=1) DO
 BEGIN

   DLL:=((3/15)*(DU-DL))+DL;
   Kij:=DLL;
   WHILE (COUNTIT<=NUMOFT)DO
   BEGIN
   XX1:=XX1group[COUNTIT];
```

```
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
T:=Tgroup[COUNTIT];
Pex:=0.1013;
P:=Pex;
ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);

SUM:=SUM+((Pex-P)*(Pex-P)/Pex);
COUNTIT:=COUNTIT+1;
END;
FUNCL:=SUM;
WRITELN('FUNCL = ',FUNCL);

COUNTIT:=1;
DUU:=((5/15)*(DU-DL))+DL;
Kij:=DUU;
WHILE (COUNTIT<=NUMOFT)DO
BEGIN
XX1:=XX1group[COUNTIT];
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
T:=Tgroup[COUNTIT];
Pex:=0.1013;
P:=Pex;
ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);
SUM:=SUM+((Pex-P)*(Pex-P)/Pex);
COUNTIT:=COUNTIT+1;
END;
FUNCU:=SUM;
WRITELN('FUNCU = ',FUNCU);

IF(DUU-DLL-EPS > 0) THEN
BEGIN
FUL:=FUNCU-FUNCL;
        IF(FUL>0) THEN
```

```
        BEGIN
          DU:=DUU;
          CONTINUE;
        END
        ELSE
        BEGIN
          DL:=DLL;
          CONTINUE;
        END;
END
ELSE
BEGIN
Kij:=(DLL+DUU)/2;
WRITE('Kij Answer : ',Kij);
{This part use for show Pcal of all temperatures }

writeln(' sum = ',sum:10:8);
COUNTIT:=1;
WHILE (COUNTIT<=NUMOFT)DO
BEGIN
XX1:=XX1group[COUNTIT];
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
T:=Tgroup[COUNTIT];
Pex:=0.1013;
P:=Pex;


ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);
WRITELN('Pcal of temperature ',Tgroup[COUNTIT],' = ',P,'MPa');
COUNTIT:=COUNTIT+1;
END;
EXIT;
END;
END;
END;
```

```
    COUNTIT:=1;
    WHILE (COUNTIT<=NUMOFT)DO
    BEGIN
    ROOTofQEOS(XX1group[COUNTIT],XX2group[COUNTIT],Y1group[COUNTIT],
    Y2group[COUNTIT],Kij,Tgroup[COUNTIT],Pex);
    WRITELN('Pcal of temperature ',Tgroup[COUNTIT],' = ',P,'MPa');
    COUNTIT:=COUNTIT+1;
    END;
    EXIT;
    END;
  END;
END;
```

```
IF (steady='T') OR (steady='t') THEN
BEGIN

write('Please enter no.of pressure data points:  ');
readln(NUMOFP);
write('Please enter upper Kij value  ');
readln(DU);
write('Please enter lower Kij value  ');
readln(DL);

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter Pexgroup[',COUNTIT,']:  ');
  readln(Pexgroup[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
```

```
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter XX1[',COUNTIT,']: ');
  readln(XX1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter XX2group[',COUNTIT,']: ');
  readln(XX2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter Y1group[',COUNTIT,']: ');
  readln(Y1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter Y2group[',COUNTIT,']: ');
  readln(Y2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

 EPS:=0.000001;
 COUNTIT:=1;

 WHILE (1=1) DO
 BEGIN
```

```
DLL:=((3/32)*(DU-DL))+DL;
Kij:=DLL;
WHILE (COUNTIT<=NUMOFP)DO
BEGIN
XX1:=XX1group[COUNTIT];
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
P:=Pexgroup[COUNTIT];
ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);

SUM:=SUM+((Pexgroup[COUNTIT]-P)*(Pexgroup[COUNTIT]-P)/Pexgroup[COUNTIT]);
COUNTIT:=COUNTIT+1;
END;
FUNCL:=SUM;
WRITELN('FUNCL = ',FUNCL);

COUNTIT:=1;
DUU:=((5/32)*(DU-DL))+DL;
Kij:=DUU;
WHILE (COUNTIT<=NUMOFP)DO
BEGIN
XX1:=XX1group[COUNTIT];
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
P:=Pexgroup[COUNTIT];
ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);

SUM:=SUM+((Pexgroup[COUNTIT]-P)*(Pexgroup[COUNTIT]-P)/Pexgroup[COUNTIT]);
COUNTIT:=COUNTIT+1;
END;
FUNCU:=SUM;
WRITELN('FUNCU = ',FUNCU);


IF(DUU-DLL-EPS > 0) THEN
```

```
    BEGIN
    FUL:=FUNCU-FUNCL;
            IF(FUL>0) THEN
            BEGIN
               DU:=DUU;
               CONTINUE;
            END
            ELSE
            BEGIN
               DL:=DLL;
               CONTINUE;
            END;
    END
    ELSE
    BEGIN
    Kij:=(DLL+DUU)/2;
    WRITE('Kij Answer : ',Kij:10:8);
    writeln(' sum = ',sum:10:8);
    EXIT;
    END;
 END;
 END;

END.
```

```
{PROGRAM FOR PENG - ROBINSON EQUATION OF STATE}
Program_ Peng_Robinson_Equation_of_state;
Uses Strings,CRT;
VAR BC1,BC2,VC1,VC2,P1,P2,Tc1,Tc2,B1,B2,BMIX,T,P,XX1,XX2,Y1,Y2:REAL;
  W1,W2,pc1,pc2,DC1,DC2:REAL;
  Dipolemoment1,Dipolemoment2:REAL;
  TR1,ac1,a1:REAL;
  TR2,Z1,Z2,Z3,Z4,ac2,a2:REAL;
  AMIX,Q2,Q3,Q4:REAL;
  P1sat,P2sat,Tex,Pex,Ts,Te,ITV,Kij,min,Kanswer,Tope,SUM:REAL;
  NUMOFP,NUMOFT,COUNTIT,i:INTEGER;
  Pgroup:ARRAY[0..30]OF REAL;
  Pexgroup:ARRAY[0..30]OF REAL;
  Tgroup:ARRAY[0..30]OF REAL;
  XX1group:ARRAY[0..30]OF REAL;
  XX2group:ARRAY[0..30]OF REAL;
  Y1group:ARRAY[0..30]OF REAL;
  Y2group:ARRAY[0..30]OF REAL;
  zl,zv,ANSWER,DU,DL,EPS,DUU,DLL,FUNC,FUNCL,FUNCU,FUL:REAL;
  DPFL11,DPFI ',PFLV1,VLP1,PFLP1,DIVI:REAL;
  ALPHA11,ALPHA22,ALPHA1,ALPHA2:REAL;
  AQ,BQ:REAL;
  Input:text;
  Fname1,Fname2,Fname3,Fname4,substance1,substance2:Array [0..29] of Char;
  kind1,kind2:Array [0..9] of Char;
  Found1,Found2:Integer; {strpos}
  steady:Char;
  {Addition Variables}
  Po,Len:Integer;
  {test variables}
  sub1,sub2:string;
```

```
  output:text;

  Pexp:REAL;

Function COMPRESS_FACTOR(Q2,Q3,Q4,XX1,XX2,Y1,Y2:REAL):REAL;
  VAR S,E,A,B,BEGIN_VALUE,INCRE:REAL;
    RESULT:ARRAY[1..4] OF REAL;
    INDEX,COUNTER,AGAIN:INTEGER;

     VL,VV:REAL;
     FDIF,FN,PFLP1,PFLV1,VLP1:REAL;

     PFL1,PFV1,CPFV1,DPFL1:REAL;
     PFGP1,PFGV1:REAL;
     BETA1,BETA2,BETA,DFPL11:REAL;
     PHI1,PHI2,PHI,CPFV11:REAL;
     VGP1:REAL;

     {NUBER OF LOOP}
     Loop_No:INTEGER;

BEGIN
  BEGIN_VALUE:=0;
  COUNTER:=0;
  INCRE:=0.05;
  WRITELN;

  WHILE(BEGIN_VALUE<=1) AND (COUNTER<3) DO
  BEGIN
     S:=1;
     E:=0.000005;
     A:=BEGIN_VALUE;
     WHILE(ABS(S)>E) DO
```

```
BEGIN
   B:=A;
   A:=B-((B*B*B+(Q2*B*B)+(Q3*B)+Q4)/(3*B*B+2*Q2*B+Q3));
   S:=(A*A*A)+(Q2*A*A)+(Q3*A)+Q4;
END;
IF (COUNTER=0) THEN
BEGIN
   BEGIN_VALUE:=BEGIN_VALUE+INCRE;
   IF (A>=0)AND (A<=1) THEN
   BEGIN
      COUNTER:=COUNTER+1;
      RESULT[COUNTER]:=A;
      {this is  a test}
      WRITELN('ANSWER (',COUNTER,') IS ',RESULT[COUNTER]:10:8);

   END;
   CONTINUE;
END;
IF (COUNTER>0) THEN
BEGIN
  { IF COUNTER=3 THEN EXIT;}
   IF (A<0) OR (A>1) THEN
   BEGIN
      BEGIN_VALUE:=BEGIN_VALUE+INCRE;
      CONTINUE;
   END;
   INDEX:=1;

   AGAIN:=0;
   WHILE(INDEX<=COUNTER) DO
   BEGIN
      IF(  ABS(A-RESULT[INDEX]) < 0.01) THEN
      BEGIN
```

```
            INDEX:=INDEX+1;
            AGAIN:=1;
            CONTINUE;
          END;
          INDEX:=INDEX+1;
        END;
        IF(AGAIN=0) THEN
        BEGIN
          COUNTER:=COUNTER+1;
          RESULT[COUNTER]:=B;

        END;
      END;
      BEGIN_VALUE:=BEGIN_VALUE+INCRE;
  END;
  IF (COUNTER=0) THEN
  BEGIN
    WRITELN;
    WRITELN('NO ANSWER');
  END;

  IF (COUNTER<2) OR (COUNTER>3) THEN EXIT;

  ZL:=RESULT[1];
  IF (COUNTER=2) THEN
    ZV:=RESULT[2]
  ELSE
    ZV:=RESULT[3];

{   WRITELN(' ZL = ',ZL:10:8,' ZV = ',ZV:10:8);}

{PROGRAM CALCULATION PARTIAL FUGACITY COEFFICIENT
```

```
FOR VAPOR &LIQUID PHASE IN BINARY MIXTURE}

  PFV1:=5;
  PFL1:=3;

  P:=((XX1*P1sat)+(XX2*P2sat))/2;
  ANSWER:=P;
  writeln('Pex =',Pex:10:8,' P = ',P:10:8);

 WHILE (Abs((XX1*PFL1)-(Y1*PFV1))>0.001) DO
  Loop_No:=0;
  BEGIN
    VL:=(ZL*0.008314*T/P);
    VV:=(ZV*0.008314*T/P);

    {vapour phase}
 CPFV1:=(((B1/BMIX)*(ZV-1))-(ln(ZV-BMIX))+((AMIX/(4.828*BMIX))
     *((B1/BMIX)-((2/AMIX)*Y2*(1-Kij)*sqrt(A1*A2)))))
     *ln((ZV+(2.41*BMIX))/(ZV-(0.414*BMIX)));

    {liquid phase}
 DPFL1:=(((B1/BMIX)*(ZL-1))-(ln(ZL-BMIX))+((AMIX/(4.828*BMIX))
     *((B1/BMIX)-((2/AMIX)*XX2*(1-Kij)*sqrt(A1*A2)))))
     *ln((ZL+(2.41*BMIX))/(ZL-(0.414*BMIX)));
    PFV1:=EXP(CPFV1);
    PFL1:=EXP(DPFL1);
     {THIS PART TO SET INITIAL PRESSURE}
     {LIQUID}
 BETA1:=ZL+(2.414*BMIX);
 BETA2:=ZL-(0.414*BMIX);
 BETA:=(AMIX/(4.828*BMIX))*((B1/BMIX)-((2*XX2*(1-Kij)*SQRT(A1*A2))
     /AMIX));
DPFL11:=((P/(0.008314*T))*((B1/BMIX)+(BETA*(BETA2-BETA1)/(BETA2*BETA1))))
```

```
    -(1/(VL-BMIX));

 PFLV1:=EXP(DPFL1)*DPFL11;
  VLP1:=-(ZL*0.008314*T/(P*P));
 PFLP1:=PFLV1*VLP1;

    {VAPOR}
  PHI1:=ZV+(2.414*BMIX);
  PHI2:=ZV-(0.414*BMIX);
   PHI:=(AMIX/(4.828*BMIX))*((B1/BMIX)-((2*Y2*(1-Kij)*SQRT(A1*A2))
    /AMIX));
 CPFV11:=((P/(0.008314*T))*((B1/BMIX)+(PHI*(PHI2-PHI1)/(PHI2*PHI1))))
    -(1/(VV-BMIX));
 PFGV1:=EXP(CPFV1)*CPFV11;
  VGP1:=-(ZV*0.008314*T/(P*P));
 PFGP1:=PFGV1*VGP1;

    {FINAL PROPOSE EQUATION}
    DIVI:=(Abs((XX1*PFL1)-(Y1*PFV1)));
    FDIF:=(XX1*PFLP1)-(Y1*PFGP1);
     FN:=(XX1*PFL1)-(Y1*PFV1);
    P:=P-(FN/FDIF);
{     writeln('Old P = ',ANSWER:10:8,' New P = ',P:10:8);}
    IF (P>Pex) THEN
    begin
       P:=ANSWER;
       Loop_No:=30;
    end
    else if(P < 0) THEN
    begin
      Loop_No:=30;
    end
    else IF (P > ANSWER ) THEN
```

```
      begin
        ANSWER:=P;
      end;
      Loop_No:=Loop_No+1;

          END;
    WRITELN('PCAL = ',ANSWER:10:8,' MPa');
    writeln('No. of loop = ',Loop_No);
    writeln('KIJ = ',KIJ:10:8);


{    WRITELN('DIVIATION = ',DIVI:10:8);}

END;
   FUNCTION ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P:REAL):REAL;
   BEGIN

   Pex:=P;
   ALPHA11:=1+((0.37646+(1.54226*W1)-(0.26992*W1*W1))*(1-SQRT(TR1)));
   ALPHA22:=1+((0.37646+(1.54226*W2)-(0.26992*W2*W2))*(1-SQRT(TR2)));
    ALPHA1:=ALPHA11*ALPHA11;
    ALPHA2:=ALPHA22*ALPHA22;
      AC1:=0.457235*(0.008314*0.008314*TC1*TC1)/PC1;
      AC2:=0.457235*(0.008314*0.008314*TC2*TC2)/PC2;
       A1:=AC1*ALPHA1;
       A2:=AC2*ALPHA2;
     AMIX:=((Y1*Y1*A1)+(2*Y1*Y2*(SQRT(A1*A2))*(1-Kij))+(Y2*Y2*A2));
       B1:=0.077796*0.008314*TC1/PC1;
       B2:=0.077796*0.008314*TC2/PC2;
     BMIX:=(Y1*B1)+(Y2*B2);

   AQ:=AMIX*P/(0.008314*0.008314*T*T);
   BQ:=BMIX*P/(0.008314*T);
```

```
Q4:=-1*((AQ*BQ)-(BQ*BQ)-(BQ*BQ*BQ));
Q3:=AQ-(2*BQ)-(3*BQ*BQ);
Q2:=-1*(1-BQ);
COMPRESS_FACTOR(Q2,Q3,Q4,XX1,XX2,Y1,Y2);
END;

BEGIN {Main}
 clrscr;
 Assign (Input,'C:\TP\data\datafile.dat');
 Reset(Input);
 {Temp file}
 Assign (output,'c:\tp\data\temp.dat');
 Rewrite(output);

 Write('Enter name of the substance1: ');Readln(Fname1);
 Found1:=0;
 WHILE(Found1=0) DO
 BEGIN
    WHILE NOT EOF(Input) DO
    BEGIN
       Readln(Input,Fname3);
       Len:=StrLen(Fname1);
       Po:=StrLComp(StrLower(Fname1),StrLower(Fname3),Len);
       If (Po=0) then
       BEGIN
            Found1:=1;
            Break;
       END;
    END;
    IF (Found1=0) THEN
    BEGIN
       Write('Enter New Substance1 again: ');Readln(Fname1);
       Reset(Input);
```

```
    END;
END;

Reset(Input);
Write('Enter name of the substance2: ');Readln(Fname2);
Found2:=0;
WHILE(Found2=0) Do
BEGIN
    WHILE NOT EOF(Input) DO
    BEGIN
        Readln(Input,Fname4);
        Len:=StrLen(Fname2);
        Po:=StrLComp(StrLower(Fname4),StrLower(Fname2),Len);
        If (Po=0) then
        BEGIN
            Found2:=1;
            Break;
        END;
    END;
    IF(Found2=0)THEN
    BEGIN
        Write('Enter New Substance2 again: ');Readln(Fname2);
        Reset(Input);
    END;
END;
Reset(Input);
readln(Input);
readln(Input);
WHILE NOT EOF(Input) DO
BEGIN
    Readln(Input,substance1,kind1,Tc1,Pc1,Dc1,DipoleMoment1,Vc1,W1);
    Len:=StrLen(Fname1);
```

```
    Po:=StrLComp(StrLower(substance1),StrLower(Fname1),Len);
    If (Po=0) then
       Break;
 END;

 Reset(Input);
 Readln(Input);
 Readln(Input);
 WHILE NOT EOF(Input) DO
 BEGIN
    readln(Input,substance2,kind2,Tc2,Pc2,Dc2,DipoleMoment2,Vc2,W2);
    Len:=StrLen(Fname2);
    Po:=StrLComp(StrLower(substance2),StrLower(Fname2),Len);
    If (Po=0) then
       Break;
END;

write('Enter Temperature(K) : ');readln(T);
 Tex:=T;
 Write('Enter Pressure (MPa) : ');readln(P);
 Pex:=P;

 write('Enter XX1 : ');readln(XX1);
 write('Enter XX2 : ');readln(XX2);
 write('Enter Y1 : ');readln(Y1);
 write('Enter Y2 : ');readln(Y2);

 write('Enter P1sat: ');readln(P1sat);
 write('Enter P2sat: ');readln(P2sat);
{
 ROOTofQEOS(XX1,XX2,Y1,Y2,0,T,P);
 }
 write('SELECT Pconst. OR Tconst. (T,P): ');
```

```
readln(steady);
IF (steady='P') OR (steady='p') THEN
BEGIN

write('Please enter no.of Temperature data points: ');
readln(NUMOFT);
write('Please enter upper Kij value ');
readln(DU);
write('Please enter lower Kij value ');
readln(DL);



COUNTIT:=1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter Tgroup[',COUNTIT,']: ');
  readln(Tgroup[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter XX1[',COUNTIT,']: ');
  readln(XX1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:= 1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter XX2group[',COUNTIT,']: ');
```

```
  readln(XX2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter Y1group[',COUNTIT,']: ');
  readln(Y1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFT)DO
BEGIN
  write('please enter Y2group[',COUNTIT,']: ');
  readln(Y2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;
 EPS:=0.000001;
 WHILE (1=1) DO
 BEGIN

    DLL:=((3/15)*(DU-DL))+DL;
    Kij:=DLL;
    WHILE (COUNTIT<=NUMOFT)DO
    BEGIN
    XX1:=XX1group[COUNTIT];
    XX2:=XX2group[COUNTIT];
    Y1:=Y1group[COUNTIT];
    Y2:=Y2group[COUNTIT];
    T:=Tgroup[COUNTIT];
    ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);
```

```
SUM:=SUM+((Pex-P)*(Pex-P)/Pex);
COUNTIT:=COUNTIT+1;
END;
FUNCL:=SUM;
WRITELN('FUNCL = ',FUNCL);

COUNTIT:=1;
DUU:=((5/15)*(DU-DL))+DL;
Kij:=DUU;
WHILE (COUNTIT<=NUMOFT)DO
BEGIN
XX1:=XX1group[COUNTIT];
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
T:=Tgroup[COUNTIT];
ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);

SUM:=SUM+((Pex-P)*(Pex-P)/Pex);
COUNTIT:=COUNTIT+1;
END;
FUNCU:=SUM;
WRITELN('FUNCU = ',FUNCU);

IF(DUU-DLL-EPS > 0) THEN
BEGIN
FUL:=FUNCU-FUNCL;
        IF(FUL>0) THEN
        BEGIN
           DU:=DUU;
           CONTINUE;
        END
```

```
            ELSE
            BEGIN
               DL:=DLL;
               CONTINUE;
            END;
      END
      ELSE
      BEGIN
      Kij:=(DLL+DUU)/2;
      WRITE('Kij Answer : ',Kij);
      {This part use for show Pcal of all temperatures }

      COUNTIT:=1;
      WHILE (COUNTIT<=NUMOFT)DO
      BEGIN
      ROOTofQEOS(XX1group[COUNTIT],XX2group[COUNTIT],Y1group[COUNTIT],
      Y2group[COUNTIT],Kij,Tgroup[COUNTIT],Pex);
      WRITELN('Pcal of temperature ',Tgroup[COUNTIT],' = ',P,'MPa');
      COUNTIT:=COUNTIT+1;
      END;


      EXIT;
      END;

  END;
END;



IF (steady='T') OR (steady='t') THEN
```

```
BEGIN

write('Please enter no.of pressure data points: ');
readln(NUMOFP);
write('Please enter upper Kij value ');
readln(DU);
write('Please enter lower Kij value ');
readln(DL);

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter Pexgroup[',COUNTIT,']: ');
  readln(Pexgroup[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter XX1[',COUNTIT,']: ');
  readln(XX1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter XX2group[',COUNTIT,']: ');
  readln(XX2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;
```

```
COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter Y1group[',COUNTIT,']:  ');
  readln(Y1group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

COUNTIT:=1;
WHILE(COUNTIT<=NUMOFP)DO
BEGIN
  write('please enter Y2group[',COUNTIT,']:  ');
  readln(Y2group[COUNTIT]);
  COUNTIT:=COUNTIT+1;
END;

 EPS:=0.000001;
 COUNTIT:=1;

 WHILE (1=1) DO
 BEGIN

    DLL:=((3/15)*(DU-DL))+DL;
    Kij:=DLL;
    WHILE (COUNTIT<=NUMOFP)DO
    BEGIN
    XX1:=XX1group[COUNTIT];
    XX2:=XX2group[COUNTIT];
    Y1:=Y1group[COUNTIT];
    Y2:=Y2group[COUNTIT];
    P:=Pexgroup[COUNTIT];
    ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);
```

```
SUM:=SUM+((Pexgroup[COUNTIT]-P)*(Pexgroup[COUNTIT]-P)/Pexgroup[COUNTIT]);
COUNTIT:=COUNTIT+1;
END;
FUNCL:=SUM;
WRITELN('FUNCL = ',FUNCL);

COUNTIT:=1;
DUU:=((5/15)*(DU-DL))+DL;
Kij:=DUU;
WHILE (COUNTIT<=NUMOFP)DO
BEGIN
XX1:=XX1group[COUNTIT];
XX2:=XX2group[COUNTIT];
Y1:=Y1group[COUNTIT];
Y2:=Y2group[COUNTIT];
P:=Pexgroup[COUNTIT];
ROOTofQEOS(XX1,XX2,Y1,Y2,Kij,T,P);

SUM:=SUM+((Pexgroup[COUNTIT]-P)*(Pexgroup[COUNTIT]-P)/Pexgroup[COUNTIT]);
COUNTIT:=COUNTIT+1;
END;
FUNCU:=SUM;
WRITELN('FUNCU = ',FUNCU);


IF(DUU-DLL-EPS > 0) THEN
BEGIN
FUL:=FUNCU-FUNCL;
        IF(FUL>0) THEN
        BEGIN
           DU:=DUU;
           CONTINUE;
        END
```

```
            ELSE
            BEGIN
               DL:=DLL;
               CONTINUE;
            END;
      END
      ELSE
      BEGIN
      Kij:=(DLL+DUU)/2;
      WRITE('Kij Answer : ',Kij:10:8);
      writeln(' sum = ',sum:10:8);

      EXIT;

      END;
```


```
  END;
  END;

END.
```

APPENDIX B

Explanation of variables used in the computer program

ZL = Z^l (see Notation)

ZV = Z^v (see Notation)

VV = V^v (see Notation)

VL = V^l (see Notation)

BMIX = βmix

EMIX = emix

CMIX = cmix

AMIX = amix

FBV = $\dfrac{\partial (\ln \phi^v)_{a,c,e}}{\partial \beta}$

FBL = $\dfrac{\partial (\ln \phi^l)_{a,c,e}}{\partial \beta}$

BNIV = $n(\partial\beta/\partial n_i)_j$ in vapor phase

BNIL = $n(\partial\beta/\partial n_i)_j$ in liquid phase

FCV = $\dfrac{\partial (\ln \phi^v)_{a,e,\beta}}{\partial c}$

FCL = $\dfrac{\partial (\ln \phi^l)_{a,e,\beta}}{\partial c}$

CNIV = $n(\partial c/\partial n_i)_j$ in vapor phase

CNIL = $n(\partial c/\partial n_i)_{jj}$ in liquid phase

FAV = $\dfrac{\partial (\ln \phi^v)_{c,e,\beta}}{\partial a}$

FAL = $\dfrac{\partial (\ln \phi^l)_{c,e,\beta}}{\partial a}$

ANIV = $n(\partial a/\partial n_i)_j$ in vapor phase

ANIL = $n(\partial a/\partial n_i)_{jj}$ in liquid phase

FEV = $\dfrac{\partial (\ln \phi^v)_{c,a,\beta}}{\partial e}$

FEL = $\frac{\partial (\ln \phi)_{c,a,\beta}}{\partial e}$

ENIV = $n(\partial e/\partial n_i)_j$ in vapor phase

ENIL = $n(\partial e/\partial n_i)_j$ in liquid phase

NIY = $n(\partial \ln \phi^v / \partial n_i)_j$

NIX = $n(\partial \ln \phi^l / \partial n_i)_{jj}$

FV1 = $\ln \phi^v$

FL1 = $\ln \phi^l$

PFV1 = $\Lambda \phi^v_i$

PFL1 = $\Lambda \phi^l_i$

XX1 = mole fraction in liquid phase of component 1

XX2 = mole fraction in liquid phase of component 2

Y1 = mole fraction in vapor phase of component 1

Y2 = mole fraction in vapor phase of component 2

DU = Upper limit of interaction parameter

DL = Lower limit of interaction parameter

Function COMPRESS_FACTOR this function calculates compressibility factor in vapor phase (Z^V) and compressibility factor in liquid phase (Z^L) of the system .

Function ROOTofQEOS this function calculates the parameters of Quartic equation of state : c , e , a, β for binary fluids .

APPENDIX C

PHYSICAL PROPERTIES OF PURE SUBSTANCE

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
ACETALDEHYDE	**polar**	461	5.642	6.494	2.5	0.154	0.303
ACETIC ACID	**polar**	594.6	5.794	5.845	1.74	0.171	0.4624
ACETONE	**polar**	508	4.761	4.614	2.88	0.209	0.3064
ACETONITILE	**polar**	547.7	4.832	5.854	3.87	0.212	0.3498
ACETYLENE	**nonpolar**	309	6.281	8.885	0	0.113	0.1873
AMMONIA	**polar**	405.4	1.129	13.79	1.47	0.073	0.2515
ANILINE	**polar**	699	5.379	3.649	1.6	0.274	0.384
BENZENE	**nonpolar**	561.5	4.832	3.892	0	0.259	0.2108
BENZOIC ACID	**polar**	752	4.619	2.9333	1.7	0.341	0.62
BROMOBENZENE	**polar**	670	4.518	3.098	1.7	0.324	0.251
1,3 BUTADIENE	**nonpolar**	425	4.326	4.537	0	0.221	0.1932
n-BUTANE	**nonpolar**	426	3.647	3.9216	0	0.255	0.1913
1-BUTANOL	**polar**	563	4.417	3.649	1.66	0.274	0.593

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
2-BUTANOL	polar	536.1	4.234	3.718	1.7	0.269	0.577
2-BUTANONE	polar	535.5	4.153	3.75	3.2	0.267	0.3241
1-BUTENE	polar	419.6	4.072	4.167	0.3	0.24	0.191
n-BUTYLACETATE	polar	579	3.181	2.5	1.8	0.4	0.417
n-BUTYL ALCOHOL	polar	560	4.903	3.649	1.66	0.274	0.3516
s-BUTYL ALCOHOL	polar	538	4.194	3.731	1.66	0.268	0.6882
CARBONDIOXIDE	nonpolar	304.1	7.395	10.45	0	0.094	0.2276
CARBONDISULFIDE	polar	552	8.003	6.25	0	0.16	0.109
CARBONMONOXIDE	nonpolar	132.9	3.487	10.741	0.11	0.093	0.0663
CARBONTETRACHLORIDE	polar	556.1	4.559	4.559	0	0.0276	0.1926
CARBONYL SULFIDE	polar	378.8	6.161	7.402	0.71	0.135	0.1041
CHLOROBENZENE	nonpolar	632	4.518	3.244	1.69	0.308	0.2505
1-CHLOROBUTANE	polar	542	3.728	3.206	2	0.312	0.218
2-CHLOROBUTANE	polar	520.6	4.001	3.279	2.1	0.305	0.3

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
CHLOROFORM	polar	536.4	5.454	4.184	1.01	0.239	0.2129
CHLOROTRIFLUOROMETHANE	polar	302	3.92	5.543	0.5	0.5	0.198
CYCLOHEXANE	nonpolar	554	4.093	3.214	0	0.311	0.2149
CYCLOHEXENE	polar	560.4	4.396	3.323	0.6	0.301	0.21
DICHLORODIFLUOROMETHANE	polar	384.5	4.007	4.587	0.51	0.51	0.1796
1,1 DICHLOROETHANE	polar	523	5.134	4.242	0.24	0.24	0.2477
1,2 DICHLOROETHANE	polar	561	5.369	4.444	2.06	0.225	0.299
DIETHYLAMINE	polar	496.5	3.667	3.37	0.92	0.301	0.299
DIETHYL ETHER	polar	466.7	3.626	3.571	1.15	0.28	0.2846
DIMETHYL ETHER	polar	400	5.369	5.261	1.3	0.178	0.2036
DIMETHYL SULFIDE	nonpolar	503	5.602	4.975	1.5	0.201	0.191
ETHANE	nonpolar	305.1	4.943	6.876	0	0.145	0.0989
ETHANOL	polar	516.3	6.383	5.989	1.69	0.167	0.6371
ETHYL ACETATE	polar	523.1	3.892	3.496	1.78	0.286	0.3611
ETHYLBENZENE	polar	617.2	3.647	2.674	0.4	0.374	0.302
ETHYL BUTYLATE	polar	566	3.039	2.379	1.74	0.395	0.461
ETHYL CHLORIDE	polar	460.2	5.268	5.115	2.06	0.196	0.1905

280

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
ETHYLCYCLOHEXANE	nonpolar	609	3.039	2.222	0	0.45	0.243
ETHYL ETHER	polar	467.6	3.596	3.547	1.15	0.282	0.4
ETHYL FORMATE	polar	508.5	4.802	4.367	2	0.229	0.285
ETHYLENE	nonpolar	282.7	5.116	7.857	0	0.129	0.0852
ETHYLENE GLYCOL	polar	645	7.8	5.236	2.2	0.191	1.136
ETHYL METHYL ETHER	polar	437.7	4.396	4.5	1.23	0.221	0.4
n- HEPTANE	polar	539.8	2.715	2.335	0.34	0.432	0.3494
n-HEXANE	nonpolar	507.8	2.988	2.715	0	0.37	0.3047
1-HEXENE	polar	504	3.211	2.857	0.4	0.35	0.285
HYDROCHLORIC ACID	polar	324.7	8.418	12.36	1.1	0.081	0.133
HYDROGEN FLUORIDE	polar	461	6.564	14.45	1.9	0.069	0.329
HYDDROGEN SULFIDE	polar	373.2	9.056	10.14	0.9	0.099	0.081
ISOBUTANE	nonpolar	407	3.748	3.807	0.05	0.263	0.177
ISOBUTYL ACETATE	polar	561	3.14	2.422	1.87	0.414	0.455
ISOBUTYL ALCOHOL	polar	547.8	4.356	3.662	1.7	0.273	0.592
ISOPENTANE	nonpolar	460.8	3.323	0.25	0	0.306	0.227
ISOPROPYL ACETATE	polar	549.4	3.373	2.899	1.8	0.345	0.391
METHANOL	polar	513	7.972	8.498	1.7	0.119	0.5656

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
METHYL ACETATE	polar	506.7	4.69	4.392	1.679	0.228	0.3253
METHYL CHLORIDE	polar	416.3	6.646	7.194	1.87	0.139	0.1529
METHYLCYCLOHEXANE	nonpolar	572.1	3.466	2.908	0	0.344	0.235
METHYL ETHYL ETHER	polar	437.7	4.396	4.5	1.23	0.221	0.2189
METHYL ETHYL KETONE	polar	536.8	4.265	3.745	3.3	0.267	0.32
METHYL FLUORIDE	polar	317.7	6.262	8.85	1.85	0.113	0.2037
METHYL FORMATE	polar	487.2	6.078	5.814	1.8	0.172	0.257
METHYL ISOBUTYLATE	polar	540.55	3.414	2.951	1.98	0.339	0.362
NAPTHALENE	nonpolar	748.4	4.103	2.421	0	0.413	0.302
NITROMETHANE	polar	588	6.392	5.774	3.1	0.173	0.31
NONENE	polar	592	2.37	1.724	0.59	0.58	0.3962
n-OCTANE	nonpolar	569	2.492	2.049	0	0.492	0.587
1-OCTANOL	polar	652.5	2.897	2.041	2	0.49	0.386
1-OCTENE	polar	566.7	2.654	2.155	0.3	0.464	0.2486
n-PENTANE	nonpolar	470.2	3.343	3.222	0	0.304	0.579
1-PENTANOL	polar	588.2	3.961	3.068	1.7	0.326	0.233
1-PENTENE	polar	464.8	3.576	3.3333	0.4	0.3	0.438
PHENOL	nonpolar	694.2	6.209	4.367	1.6	0.15	0.1517

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
PROPANE	nonpolar	369.8	4.255	4.989	0.084	0.2	0.6279
1- PROPANOL	polar	536.7	5.166	4.583	1.68	0.219	0.6279
2- PROPANOL	polar	508.3	4.761	4.55	1.66	0.219	0.5331
PROPIONIC ACID	polar	612.5	5.369	4.257	1.76	0.235	0.313
PROPIONITRILE	polar	564.2	4.234	4.367	3.7	0.229	0.3935
n- PROPYL ACETATE	polar	549.2	3.352	2.899	1.79	0.345	0.6279
PROPYL ALCOHOL	polar	536.7	5.06	4.542	1.67	0.219	0.3416
n- PROPYLBENZENE	polar	638.8	3.206	2.275	0.35	0.44	0.144
PROPYLENE	polar	364.9	4.659	5.525	0.4	0.181	1.106
PROPYLENE GLYCOL	polar	625	6.149	4.219	3.6	0.237	0.297
PYRIDINE	polar	617	6.08	3.355	2.2	0.298	0.612
TERTIALY BUTANOL	polar	506.2	4.022	3.636	1.7	0.275	0.2641
TOLUENE	polar	593.6	4.214	3.169	0.45	0.316	0.32
TRIETHYL AMINE	polar	299.2	3.039	2.485	0.39	0.402	0.205
TRIMETHYL AMINE	nonpolar	433.3	4.143	3.937	0.6	0.254	0.303
2,2,4 TRIMETHYLPENTANE	nonpolar	544	2.603	2.137	2.137	0.468	0.303
VINYL ACETATE	polar	525	4.407	3.774	1.7	0.265	0.34
VINYL CHLORIDE	polar	425	5.217	5.917	1.5	0.169	0.122

SUBSTANCE	KIND	Tc	Pc	Dc	Dipole moment	Vc	ω
WATER	**polar**	647.15	2.212	17.94	1.85	0.055	0.3449
m- XYLENE	**polar**	617	3.546	2.666	0.33	0.376	0.326
p- XYLENE	**polar**	616.2	3.556	2.639	0.1	0.379	0.32

VITA

Miss. Patcharee Saengsutticharittgul was born in Bangkok on November 2 ,1975. She graduated her school from Samsen Vittayalai School in 1990 and received her Bachelor of Engineering Degree in major of Chemical Engineering from the Faculty of Science , Chulalongkorn University.