```
! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/1 <<<

DHvyp=40e3    ! [J mol^-1]
                                                  40000
E=DHvyp/NA/2 ! [J]
                                          3.3211 · 10^-20
! ==> 3.3e-20 J
T=373         ! [K]
                                                    373
k*T           ! [J]
                                          5.1498 · 10^-21
exp(-E/k/T)
                                              0.0015822
! ==> prob=0.0016

! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/2 <<<

V=1e-3                ! [m^3]
                                                    0.001
l=(V/NA)↑(1/3)        ! [m]
                                          1.1842 · 10^-09
E=e↑2/4/pi/eps0/80/l ! [J]
ERROR
T=298                 ! [K]
                                                      298
k*T                   ! [J]
                                          4.1143 · 10^-21
! ==> srovnatelné s E

! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/3 <<<

! =========== a)
f=5
                                                        5
Cpsp=(f/2*R+R)/M(H2)    ! [J K^-1 g^-1]
                                                   14.436
! === b) H2 -> 2 H+ + 2 e- (4 částice)
f=3
                                                        3
Cpsp=4*(f/2*R+R)/M(H2) ! [J K^-1 g^-1]
                                                   41.245
! ========== c)
f=6
                                                        6
Cpsp=(f/2*R+R)/M(SiH4) ! [J K^-1 g^-1]
                                                    1.0355
! =========== d)
f=5
                                                        5
(f/2*R+R)/(0.2*M(O2)+0.8*M(N2)) ! [J K^-1 g^-1]
                                                    1.0101

! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/4 <<<

rho=597.13      ! [g m^-3]
                                                   597.13
Vm=M(H2O)/rho   ! [m^3 mol^-1]
                                                  0.03017
p=101325        ! [Pa]
                                          1.0132 · 10^+05
T=373.15        ! [K]
                                                   373.15
z=p*Vm/R/T
                                                   0.9853
B=(z-1)*Vm      ! [m^3 mol^-1]
                                              −0.00044335

! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/5 <<<

T=350                       ! [K]
                                                      350
B=545.4-360.7*exp(527.6/T) ! [cm^3 mol^-1]
                                                  −1083.2
B=B*1e-6                    ! [m^3 mol^-1]
                                               −0.0010832
p=150e3                     ! [Pa]
                                          1.5 · 10^+05
! tlakový rozvoj:
Vm=B+R*T/p                  ! [m^3 mol^-1]
                                                 0.018317
! objemový rozvoj
solve Vm p*Vm/R/T-1-B/Vm    ! [m^3 mol^-1]
                                                 0.018249

! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/6 <<<

a=.4613                     ! [Pa m^6 mol^-2]
                                                   0.4613
b=5.823e-5                  ! [m^3 mol^-1]
                                          5.823 · 10^-05
TB=a/R/b                    ! [K]
                                                    952.8

! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/7 <<<

T=250+273.15                ! [K]
                                                   523.15
Vm=200e-6                   ! [m^3 mol^-1]
                                                   0.0002
! ========= a) ideální plyn
p=R*T/Vm                    ! [Pa]
                                          2.1749 · 10^+07
! ========= b) van der Waals
Tc=425.12                   ! [K]
                                                   425.12
pc=3.796e6                  ! [Pa]
                                          3.796 · 10^+06
a=27/64*R↑2*Tc↑2/pc
                                                    1.3885
b=1/8*R*Tc/pc
                                                0.00011639
p=R*T/(Vm-b)-a/Vm↑2         ! [Pa]
                                          1.7313 · 10^+07
! ========== c) Redlich-Kwong
a=0.42748*R↑2*Tc↑2.5/pc
                                                    29.009
b=0.08664*R*Tc/pc
                                          8.0675 · 10^-05
p=R*T/(Vm-b)-a/sqrt(T)/Vm/(Vm+b) ! [Pa]
                                          1.3859 · 10^+07
! ========== d) diagram
Tr=T/Tc
```

1.2306

```
Vr=Vm*pc/R/Tc
```

0.21479

```
z=0.61
```

0.61

```
p=z*R*T/Vm                ! [Pa]
```

$\mathbf{1.3267 \cdot 10^{+07}}$

```
! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/8 <<<

T=21+273.15
```

294.15

```
Tc=309.6
```

309.6

```
Tr=T/Tc
```

0.9501

```
p=4.34e6          ! [Pa]
```

$\mathbf{4.34 \cdot 10^{+06}}$

```
pr=p/7.24e6
```

0.59945

```
z=0.66            ! diagram
```

0.66

```
Vm=z*R*T/p        ! [m^3 mol^-1]
```

0.00037193

```
V=10e-3           ! [m^3]
```

0.01

```
m=M(N2O)*V/Vm     ! [g]
```

1183.4

```
! >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/9 <<<

T=320             ! [K]
```

320

```
V=10              ! [cm^3]
```

10

```
n=7/M(CO2)
```

0.15906

```
Vm=V/n
```

62.871

```
Tc=304.2; pc=7.39 ! [K]; [MPa]
```

304.2

7.39

```
Vr=Vm*pc/R/Tc     ! [cm^3 mol^-1]
```

0.1837

```
Tr=T/Tc
```

1.0519

```
z=0.35            ! diagram
```

0.35

```
p=z*R*T/Vm        ! [MPa]
```

14.812

```
!>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/10 <<<

Tc=304.2; pc=7.39 ! [K]; [MPa]
```

304.2

7.39

```
rho=0.5           ! [g cm^-3]
```

0.5

```
Vm=M(CO2)/rho     ! [cm^3 mol^-1]
```

88.019

```
Vr=Vm*pc/R/Tc
```

0.25717

```
p=15              ! [MPa]
```

15

```
pr=p/pc
```

2.0298

```
z=0.46
```

0.46

```
T=p*Vm/R/z        ! [K]
```

345.2

```
!>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/11 <<<

x1=0.584
```

0.584

```
z1=0.780
```

0.78

```
x2=0.416
```

0.416

```
z2=0.623
```

0.623

```
T=373.15    ! [K]
```

373.15

```
p=27.6      ! [MPa]
```

27.6

```
Tc1=282.34  ! [K]
```

282.34

```
pc1=5.039   ! [MPa]
```

5.039

```
Tc2=304.17  ! [K]
```

304.17

```
pc2=7.386   ! [MPa]
```

7.386

```
!=========== a)
z=z1*x1+z2*x2
```

0.71469

```
Vm=z*R*T/p  ! [cm^3 mol^-1]
```

80.339

```
M=x1*M(C2H4)+x2*M(CO2) ! [g mol^-1]
```

34.691

```
rho=M/Vm    ! [g cm^-1]
```

0.43181

```
!========== b)
Tc=x1*Tc1+x2*Tc2
```

291.42

```
pc=x1*pc1+x2*pc2
```

6.0154

```
Tr=T/Tc; pr=p/pc
```

1.2804

4.5883

```
z=0.71
```

0.71

```
Vm=z*R*T/p  ! [cm^3 mol^-1]
```

79.812

```
rho=M/Vm    ! [g cm^-1]
```

0.43466

```
!=========== c)
a1=0.42748*R↑2*Tc1↑2.5/pc1
```

$\mathbf{7.8555 \cdot 10^{+06}}$

```
b1=0.08664*R*Tc1/pc1
```

40.363

```
a2=0.42748*R↑2*Tc2↑2.5/pc2
```

$6.456 \cdot 10^{+06}$

```
b2=0.08664*R*Tc2/pc2
```

29.666

```
a=(sqrt(a1)*x1+sqrt(a2)*x2)↑2
```

$7.2566 \cdot 10^{+06}$

```
b=x1*b1+x2*b2
```

35.913

```
solve Vm R*T/(Vm-b)-a/sqrt(T)/Vm/(Vm+b)-p
```

83.371

```
rho=M/Vm     ! [g cm^-1]
```

0.4161

```
!>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/12 <<<

rho1=0.9982            ! [g cm^-1]
```

0.9982

```
rho2=1.8305            ! [g cm^-1]
```

1.8305

```
Vsp1=1/rho1            ! [cm^3 g^-1]
```

1.0018

```
Vsp2=1/rho2            ! [cm^3 g^-1]
```

0.5463

```
w2=0.25
```

0.25

```
w1=1-w2
```

0.75

```
Vsp=w1*Vsp1+w2*Vsp2
```

0.88793

```
rho=1/Vsp
```

1.1262

```
err=(rho-1.1783)/1.1783*100 ! [%]
```

−4.4201

```
!>>>>>>>ZRUSIT>>>>>>>>>>>>>>>>>> příklad m-1/13 <<<

x1=.4; x2=.6
```

0.4

0.6

```
T=12.3+273.15; p=15 ! [K]; tlaky v [MPa]
```

285.45

15

```
p=15;
```

15

```
ERROR
Tc1=190.6; pc1=4.6
```

190.6

4.6

```
Tc2=305.3; pc2=4.87
```

305.3

4.87

```
pc=x1*pc1+x2*pc2
```

4.762

```
Tc=x1*Tc1+x2*Tc2
```

259.42

```
pr=p/pc
```

3.1499

```
Tr=T/Tc
```

1.1003

```
z=0.48              ! diagram
```

0.48

```
Vm=z*R*T/p          ! [cm^3 mol^-1]
```

75.948

```
!>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> příklad m-1/13 <<<

m=1500; V=5000; p=20.1 ! [g], [cm^3], [MPa]
```

1500

5000

20.1

```
n1=m*0.4/M(C3H8)       ! [mol]
```

13.607

```
n2=m*0.6/M(C4H10)      ! [mol]
```

15.485

```
x1=n1/(n1+n2)
```

0.46773

```
x2=n2/(n1+n2)
```

0.53227

```
Tc1=369.8; pc1=4.25    ! [K], [MPa]
```

369.8

4.25

```
Tc2=425.1; pc2=3.80    ! [K], [MPa]
```

425.1

3.8

```
pc=x1*pc1+x2*pc2
```

4.0105

```
Vc=R*(x1*Tc1/pc1+x2*Tc2/pc2) ! [cm^3 mol^-1]
```

833.46

```
Vm=V/(n1+n2)                 ! [cm^3 mol^-1]
```

171.87

```
Vr=Vm/Vc
```

0.20621

```
pr=p/pc
```

5.0119

```
z=0.77                 ! diagram
```

0.77

```
T=p*Vm/R/z             ! [K]
```

539.6