

tabel over fp, dda, log HJU  
22. feb. 1968

begin

real ltb, ilt, lpb, ilp, lps;

ny tabel: select(33); ltb:= read real; ilt:= read real; lps:= read real; ilp:= read r

begin

integer i1, i2, j, j0, i, ovr, ovrj, tæl, kcmt, cnt;

real KHI, KHeI, KHeII, ne, T, th, X, Y, Z, XH2, XH, XHeI, XHeII, xH2, xHI, xHII, xHeII, nxHeIII, gxHeII

rho, k, m0, dXH, dXHeI, dXHeII, difkvo, slogT, e, a, b, enoDeb, z, P, Pe, mu0, logP, logP0, sl

E, E1, dlogT, dlogP, T1, P1, rho1, dQ1, dQ2, cp, napla, dXH1, dXHeI1, dXHeII1, nHII, n1HII, nH2

nnel, nne2, nne3, n1xHeIII, n2xHeIII, n3xHeIII, dFn, dFx, dGn, dGx, F, gne, dne, dxHeIII, G, d

coul, kT, T32, m0mu0, Tmod5040, n1rho, n2rho, n3rho, n4rho, nne4, n4xHeIII, R, dFr, dGr, dRr,

Boolean test, test1, cvrg;

real array aF[0:11, 0:6], AA[1:3, 0:ilp];

procedure t27; writechar(27);

real procedure U(j, j0, T); value j, j0, T; integer j, j0; real T;

begin integer n; real r; r:=0; for n:=j0 step 1 until j do r:= r + 2×n<sup>1</sup>2×exp(- XH×(1

real procedure dX(z, K, T); value z, K, T; real z, K, T;

begin integer j, i; real F, m, n, r;

j:= i:= 0;

if (z+1)×K < 1<sub>10</sub><sup>-6</sup> then dX:= r:=T×K×8.617107<sub>10</sub><sup>-5</sup> else begin

if (z+1)×K > 1<sub>10</sub><sup>-2</sup> then begin

l1: j:= j+1; if j=6 then begin j:=5; ovrj:=ovrj+1; F:=2; go to l4; end; if aF[0, j] > z

l2: i:= i+1; if i=12 then begin ovr:=ovr+1; F:=aF[11, j]+(aF[11, j+1]-aF[11, j])×(z-aF[0

if aF[i, 0] > mod×ln((z+1)×K) then begin i:= i-1; go to l3 end else goto l2;

l3: n:= (mod×ln((z+1)×K)-aF[i, 0])/(aF[i+1, 0]-aF[i, 0]); m:= (z-aF[0, j])/(aF[0, j+1]-aF[0

F:= (n×aF[i+1, j]+(1-n)×aF[i, j])×(1-m)+(n×aF[i+1, j+1]+(1-n)×aF[i, j+1])×m; end else F:=

l4: dX:= r:=T×((3×(z+1)×K+1)<sup>1</sup>(2/3)-1)×F/(2×(z+1))×8.617107<sub>10</sub><sup>-5</sup>;

end;

if kb on then begin select(16); writecr; write({dd.d<sub>10</sub>-dd}, j, i, m, n, F, z, K, r); en

end;

procedure nenxHe(nne, nxHeIII, nrho, gne, gxHeIII, rho, P, T); value gne, gxHeIII, rho, P, T;

real gne, gxHeIII, P, T, nne, nxHeIII, rho, nrho;

begin

enoDeb:= exsqrt(8×pi×(gne+rho×Y×gxHeIII)/(4.0028×m0))/kT; KHI:= KHeI:= e<sup>1</sup>2×enoDeb/

z:= 1 + rho×Y×gxHeIII×2/(gnex4.0028×m0);

ovrj:=0; ovr:=0; dXH:= dXHeI:= dX(z, KHI, T); dXHeII:= dX(z, KHeII, T);

if -, test then begin if XH/dXH > 9<sub>10</sub><sup>4</sup> then j:=300 else j:= entier(sqrt(XH/dXH)); if j

dXHeIII:=dXHeII; end;

y:= gnexA/2/T32; if y > 20 then y:=20;

D:=1/(1+y×0.35355339 + 0.0575499 ×y×y); b:= D/2/y; D:= B×gne/(kT×enoDeb×enoDeb);

Pe:= gnexkT×(1+0.1768×y - 0.0033×y<sup>1</sup>2); Pcoul:= coul×enoDeb<sup>1</sup>3×(1-D×y×(0.176777+(0.015

if j≠j0 then begin

if j > j0 then U0:=U0+U(j, j0+1, T) else U0:=U0-U(j0, j+1, T); j0:=j; end;

K1:= 2/U0×b×exp(-(XH-dXH)×Tmod5040); if logT < 4.55 then begin K4:=2×k×T×rho×X/(K×m

xH2:=1-xHI-xHII; end else begin xHII:= K1/(1+K1); xHI:= 1-xHII; xH2:=0 end;

K2:=4×b×exp(-(XHeI-dXHeI)×Tmod5040);

K3:= b×exp(-(XHeII-dXHeII)×Tmod5040); xHeII:= K2/(1+K2+K2×K3); nxHeIII:= xHeII× K3

nne:= rho/m0×(xHII×X/1.00801 + (xHeII +2×gxHeIII)×Y/4.0028); enomu:=1/mu0-xH2×X/2.0160

nrho:=(P-Pe-Pr-Pcoul)×m0/kT/enomu;

end procedure nenxHe;

real procedure iter(a, b); value a, b; real a, b;

begin

real y, dy, x;

x:=0;

repeat: y:= a×x×x + b×x - 1; dy:= 2×a×x + b; x:=x-y/dy;

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if abs(y/dy) > 10-7 then go to repeat else iter:=x;
end iter;
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real procedure model(logP,logT); value logP,logT; real logP,logT;
begin real T,P;
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T:=exp(logT/mod); kT:= k×T; th:= 5040.39/T;K:=exp((12.5335050+th×(-4.9251644+th×(.056
coul:= -kT/24/pi; T32:= T1/3); Tmod5040:= 5040/T/mod; Pr:=a/3×T1/4;
P:=exp(logP/mod);j0:=0; U0:=0; tæl:=0; delt:=0.01;test1:=test;
if Pr>P then begin f:=0; ovr:=0; ovrj:=0; y:=0; go to label 3 ; end else f:=1;cnt:=0;
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top:
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errtest:=1;
nenxHe(nne1,n1xHeIII,n1rho,gne,gxHeIII,rho,P,T);
test1:=test;test:=true;
nenxHe(nne2,n2xHeIII,n2rho,gne×1.001,gxHeIII,rho,P,T);
nenxHe(nne3,n3xHeIII,n3rho,gne,gxHeIII×1.001+110-10,rho,P,T);
nenxHe(nne4,n4xHeIII,n4rho,gne,gxHeIII,rho×1.001+110-15,P,T);
test:=test1;
dFn:= (-nne2+nne1)/0.001/gne +1; dFx:=(-nne3 +nne1)/(.001×gxHeIII+110-10);dFr:=(-nr
dGn:= (-n2xHeIII + n1xHeIII)/0.001/gne; dGx:= (-n3xHeIII + n1xHeIII)/(.001×gxHeIII+1
dRn:=(-n2rho+n1rho)/.001/gne;dRx:=(-n3rho+n1rho)/(.001×gxHeIII+110-10);dRr:=(-n4rho+n1
det:=dRn×dFx×dGr+dRx×dFr×dGn+dRr×dFn×dGx-dRr×dFx×dGn-dRx×dFn×dGr-dRn×dFr×dGx;
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continue:
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F:= gne - nne1; G:= gxHeIII - n1xHeIII;
R:=rho-n1rho;
dne:=(dRr×dFx×G+dRx×F×dGr+R×dFr×dGx-R×dFx×dGr-dRx×dFr×G-dRr×F×dGx)/det;
gne:= gne+dne;if gne<10-8 then gne:=10-8;
dxHeIII:=(dRn×F×dGn+R×dGr×dFn+dRn×dFr×G-dRn×F×dGr-R×dFr×dGn-dRr×dFn×G)/det;
gxHeIII:= gxHeIII + dxHeIII; if gxHeIII<110-100 then gxHeIII:=110-100;
drho:=(R×dFx×dGn+dRx×dFn×G+dRn×F×dGx-dRn×dFx×G-dRx×F×dGn-R×dFn×dGx)/det;
rho:=rho+drho;if rho<0 then rho:=0;
if abs(dne/(gne+1))≤10-7 ^ abs(dxHeIII)+abs(drho/(rho+1))≤10-7 ^abs(drho/(rho+110-15))<1
cnt:=cnt+1;if cnt>75 then begin cvrg:=false ;go to ex;end;
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errtst:= abs(dne/(gne+1)) + abs(dxHeIII); if 2×errtst > errtest then goto top; errte
nenxHe(nne1,n1xHeIII,n1rho,gne,gxHeIII,rho,P,T); goto continue;
label 3:nenxHe(nne1,n1xHeIII,n1rho,gne,gxHeIII,rho,P,T); E:=3/2×(P+Pr+Pcoul)/rho ; nH
nHeII:=Y×xHeII/(m0×4.0028); nHeIII:=Y×gxHeIII/(m0×4.0028); EH2:= kT×(2.6757+th×(-1.4
if kb on then write(⟨-pd.ddddd⟩,T/T1,P/P1,Pe/P1,y,ln(rho)×mod,ln(E)×mod);ex;;
end model;
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select(36);
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for i:= 0 step 1 until 11 do begin
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for j:= 0 step 1 until 6 do begin
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aF[i,j]:= read real;end end;
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select(33); X:= read real; Y:= read real; Z:= read real; mu0:= 1/(X/1.00801 + Y/4.002
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start: mod:=0.43429448;pi:= 3.141592654; k:= 1.3804610-16;m0:=1.6602610-24; me:= 9.108
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a:= 7.564110-15; m0mu0:= m0×mu0; A:= h1/3/(2×pi×mexk)1/3;XH2:=4.4763; XH:=13.
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```
slogT:= read real; dlogT:= read real; slogP:= read real; dlogP:= read real;
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```
writocr; write(⟨-dd.ddd⟩,ltb); t27; write(⟨-dd.ddd⟩,ilt); t27; write(⟨-dd.ddd⟩,lps
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```
writocr; write(⟨-dd.ddd⟩,X); t27; write(⟨-dd.ddd⟩,Y); t27; write(⟨-dd.ddd⟩,Z); t27;
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```
writocr; write(⟨-dd.ddd⟩,slogT); t27; write(⟨-dd.ddd⟩,dlogT); t27; write(⟨-dd.ddd⟩,sl
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writocr;lps:= lps-slogP;negg:= exp(lps)/k/exp(ltb)×0.001;
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for logT:=ltb step slogT until ltb+ilt×slogT do begin negg:=negg;gxHeIII:=0;
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lps:=lps+slogP;
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```
writocr; write(⟨-ddd.ddd⟩,logT); t27; write(⟨-ddd.ddd⟩,lps); t27;
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T:=exp(logT/mod);
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T1:=T;
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for i2:= 0 step 1 until ilp do begin
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logP:=lps+i2×slogP;
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gne:=negg;
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test:= false;kcnt:=i2;cvrg:=true;
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P1:=exp(logP/mod);P:=exp((logP+dlogP)/mod);T:=exp((logT+dlogT)/mod);if i2=0 then rho
model(logP,logT);if -,cvrg then begin kcnt:=kcnt-1;go to out;end;
neg:=nnel; if i2=0 then negg:=neg; rho1:=rho;if f=0 then begin AA[1,i2]:=AA[2,i2]:=A
E1:=E; E1H2:=EH2; n1HII:=nHII; n1HeII:=nHeII; nHe1III:=nHeIII;n1H2:=nH2;
test:= true;
AA[1,i2]:= (P1-Pr)xm0mu0/(kxT1xrho1);
model(logP+dlogP,logT);if -,cvrg then begin kcnt:=kcnt-1;go to out;end;
dQ1:= E-E1+EH2-E1H2+(-XH2x(nH2-n1H2)+(XH-(dXH+dXH1)/2)x(nHII-n1HII)+(XHeI-(dXHeI+dXHe
+ (XHeII-(dXHeII+dXHe1II)/2+XHeI-(dXHeI+dXHeI1)/2)x(nHeIII-nHe1III))x1.6020710-12
model(logP,logT+dlogT);if -,cvrg then begin kcnt:=kcnt-1;go to out;end;
dQ2:= E-E1+EH2-E1H2+(-XH2x(nH2-n1H2)+(XH-(dXH+dXH1)/2)x(nHII-n1HII)+(XHeI-(dXHeI+dXHe
+ (XHeII-(dXHeII+dXHe1II)/2+XHeI-(dXHeI+dXHeI1)/2)x(nHeIII-nHe1III))x1.6020710-12
AA[3,i2]:=cp:= dQ2/(dlogT/mod)/P1xrho1; AA[2,i2]:= napla:= -dlogT/dlogPxdQ1/dQ2;

L2: end logP;
out:writeinteger(⌊-ddd⌋,kcnt);writecr;

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for i1:=1,2 do begin
for i2:=0 step 1 until kcnt do begin if AA[1,i2]=0 then AA[1,i2]:=AA[2,i2]:=10;
write(⌊-dd.ddd⌋,AA[i1,i2]); writechar(27); end ;writecr; end;
for i2:=0 step 1 until kcnt do begin if AA[1,i2]=10 then begin AA[1,i2]:=10;AA[2,i2]:
begin P1:=exp((lpb+i2xslogP)/mod);Pr:=a/3xT14; rho1:=(P1-Pr)/AA[1,i2]xm0mu0/k/T1;
AA[1,i2]:=AA[2,i2]xAA[3,i2]; AA[2,i2]:= ln(AA[3,i2]xsqrt(P1xAA[1,i2]xrho1))xmod;
AA[3,i2]:= ln(AA[3,i2]xP1/T1/rho1)xmod; end; end;
for i1:=2,3,1 do begin
for i2:=0 step 1 until kcnt do begin write(⌊-dd.ddd⌋,AA[i1,i2]); writechar(27); end ;
end logT; go to ny tabel; end ; end;

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	0,	1,	2,	5,	10,	30,	100,
-2.0,	0.99,	0.99,	0.99,	0.99,	0.99,	0.99,	0.99,
-1.7,	0.98,	0.98,	0.98,	0.98,	0.98,	0.98,	0.98,
-1.3,	0.97,	0.97,	0.97,	0.97,	0.97,	0.97,	0.97,
-1.0,	0.97,	0.97,	0.96,	0.96,	0.95,	0.95,	0.95,
-0.7,	0.975,	0.97,	0.96,	0.95,	0.94,	0.94,	0.94,
-0.3,	0.99,	0.98,	0.965,	0.94,	0.93,	0.93,	0.93,
0.0,	1.03,	1.01,	0.975,	0.95,	0.93,	0.92,	0.92,
0.3,	1.09,	1.05,	1.00,	0.97,	0.94,	0.93,	0.93,
0.7,	1.23,	1.14,	1.06,	1.02,	0.97,	0.95,	0.95,
1.0,	1.35,	1.24,	1.11,	1.05,	1.00,	0.97,	0.97,
1.3,	1.60,	1.38,	1.18,	1.09,	1.02,	0.98,	0.98,