Question 1, Harikrishnan R N, 18CHE147

Here I will show how to solve question 1 of the assignment by solving the cubic equation of van der waal EOS

Contents

Defining Constants

Here we define the constants, physical constants of components:

```
%Enter the Parameters Below :
P_atm = 56;         % Pressure in atm units
P = P_atm*101325;   % Pressure in Pa units
T = 450;            % Temperature in K units
Tc = 405.5;         % Critical Temperature in K units
Pc_atm = 111.3;     % Critical Pressure in atm units
Pc = Pc_atm*101325; % Critical Pressure in Pa units
R = 8.3144621;      % Universal Gas constans J/gmol-K
% Defining the Van der waal parameters a and b below :
a = (27/64)*R*R*Tc*Tc/Pc ;
b = (1/8)*R*Tc/Pc;
```

Finding the molar volume (First bit) :

Here we will see how th molar Volume is found:

```
p = [P -(R*T + P*b) a -a*b];
V = roots(p) ;
disp([ '1. ','The Molar Volume of Gas is = ', num2str(max(V)),' m^3/gmol']);
disp([ '   ','The Compressibility factor of Gas is = ', num2str(P*max(V)/R/T)]);
```

```
1. The Molar Volume of Gas is = 0.00057487 m^3/gmol
   The Compressibility factor of Gas is = 0.87183
```

Solving for the Second Bit:

```
Pr = [1 2 4 10 20] ;
for i = Pr
    P_i = Pc*i ;
    p = [P_i -(R*T + P_i*b) a -a*b];
    V = roots(p) ;
    disp([ '2. ','The Molar Volume of Gas is = ', num2str(max(real(V))),' m^3/gmol',' for Pr =', num2str(i)]);
    disp([ '   ','The Compressibility factor of Gas is = ', num2str(P_i*max(real(V))/R/T)]);
end
```

```
2. The Molar Volume of Gas is = 0.0002335 m^3/gmol for Pr =1
   The Compressibility factor of Gas is = 0.70381
2. The Molar Volume of Gas is = 7.7265e-05 m^3/gmol for Pr =2
   The Compressibility factor of Gas is = 0.46578
2. The Molar Volume of Gas is = 6.0652e-05 m^3/gmol for Pr =4
   The Compressibility factor of Gas is = 0.73126
2. The Molar Volume of Gas is = 5.0874e-05 m^3/gmol for Pr =10
   The Compressibility factor of Gas is = 1.5334
```

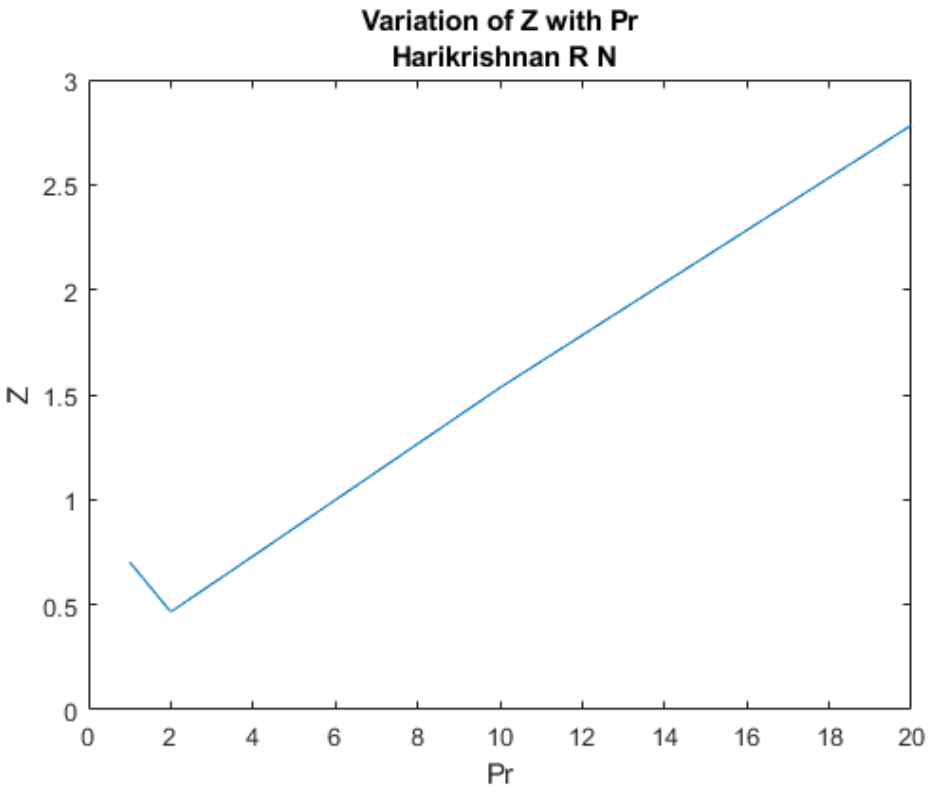
```
2. The Molar Volume of Gas is = 4.6174e-05 m^3/gmol for Pr =20
   The Compressibility factor of Gas is = 2.7835
```

Solving for the Third bit :

To show variation of compressibility factor with Pr, we can plot them :

```
Z_all = zeros(size(Pr));
j = 1;
for i = Pr
    P_i = Pc*i ;
    p = [P_i -(R*T + P_i*b) a -a*b];
    V = roots(p) ;
    Z_all(j) = P_i*max(real((V)))/R/T;
    j =j + 1;
end
disp( "3. Program will print the plot..." );
plot(Pr, Z_all);
title([" Variation of Z with Pr " ; " Harikrishnan R N"]);
xlabel( " Pr ") ; ylabel(" Z ") ;
```

```
3. Program will print the plot...
```



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