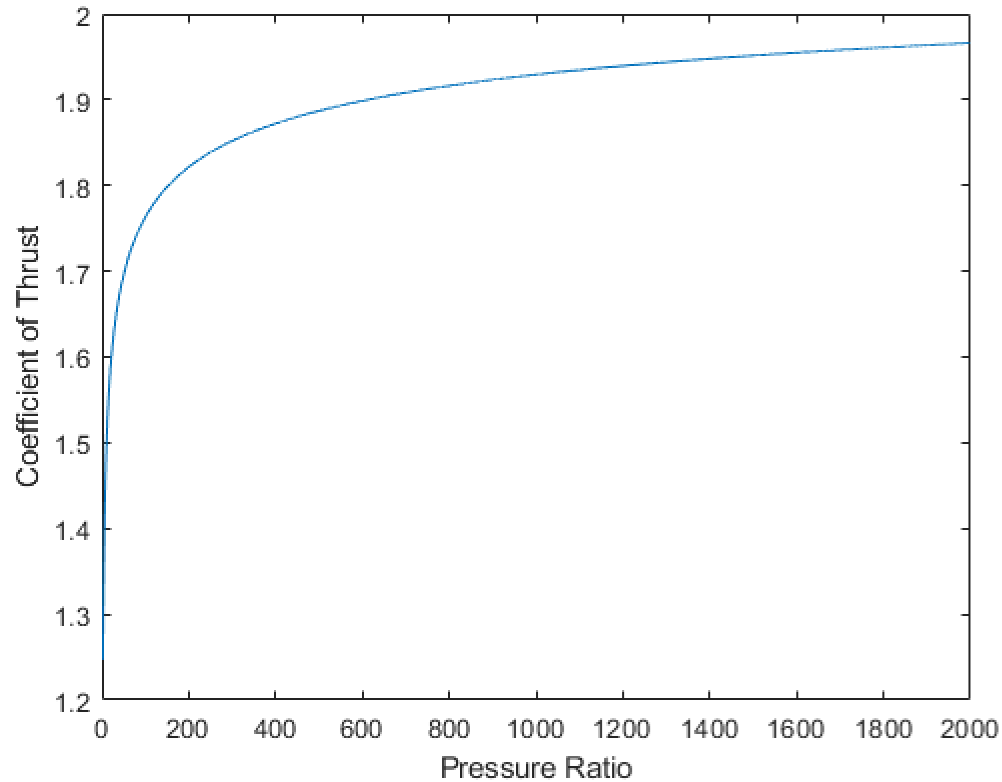
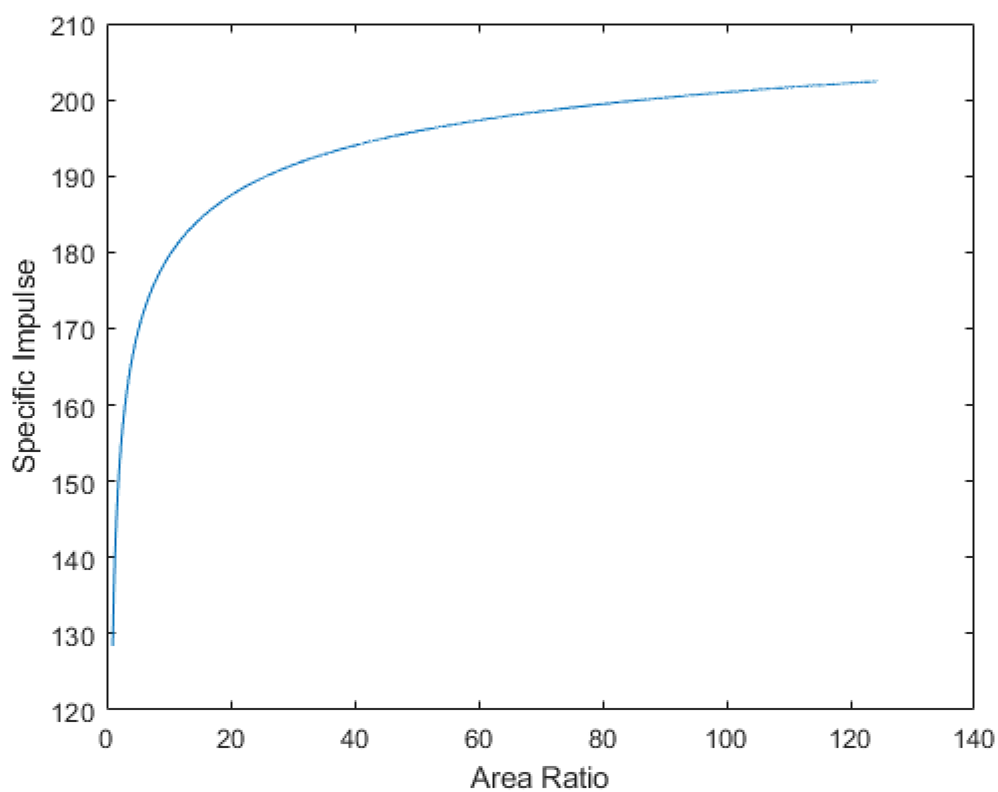
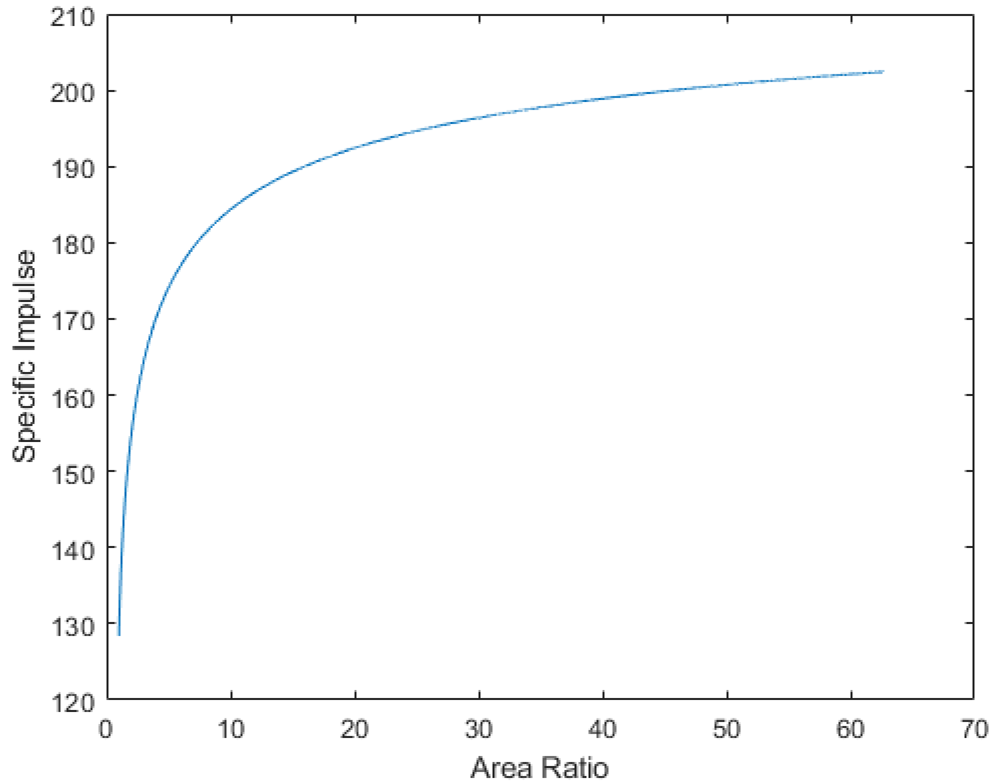
```
clear ; close all ; clc ;
Thrust = 40 ; % N
Itot = 4e4 ; % N*s
g = 9.81 ;
Ptank = 20e6 ; % Mpa
gammaH = 1.2 ;
TcH = 1650 ;
RH = 260  ;
gammaN = 1.4 ;
TcN = 300 ;
RN = 297 ;
epsa = zeros( 1 , 4 ) ;
Ispa = zeros( 1 , 4 ) ;
mdot = zeros( 1 , 4 ) ;
mp = zeros( 1 , 4 ) ;
tv = zeros( 1 , 4 ) ;
epsa(1) = 0 ;
epsa(3) = 0 ;

At = 1 ;
PR = linspace( 2 , 2e3 , 1e4 ) ;
eps = ( 2/(gammaH+1))^(1/(gammaH-1)).*(PR).^(1/gammaH).*((gammaH+1)/
(gammaH-1).*(1-(PR).^((1-gammaH)/gammaH))).^(-.5) ;
Cf = sqrt( ((2*gammaH^2)/(gammaH-1))*(2/(gammaH+1))^((gammaH+1)/
(gammaH-1)).*(1-(1./PR).^((gammaH-1)/gammaH)) ) + (1./PR).*eps;
cstar = sqrt( gammaH*RH*TcH )/( gammaH*sqrt((2/(gammaH+1))^((gammaH
+1)/(gammaH-1)) )) ;
c = Cf.*cstar ;
Isp = c / g ;
    figure
    plot( PR , Cf )
    xlabel( 'Pressure Ratio' )
    ylabel( 'Coefficient of Thrust' )
    figure
    plot( eps , Isp )
    xlabel( 'Area Ratio' )
    ylabel( 'Specific Impulse' )


% Isp = Thrust / ( mdot * g ) ;
% mp = Itot/(Isp*g) ;
index = 577 ;
epsa(2) = eps( 577 ) ;
eps = ( 2/(gammaN+1))^(1/(gammaN-1)).*(PR).^(1/gammaN).*((gammaN+1)/
(gammaN-1).*(1-(PR).^((1-gammaN)/gammaN))).^(-.5) ;
figure
    plot( eps , Isp )
    xlabel( 'Area Ratio' )
    ylabel( 'Specific Impulse' )
epsa(4) = eps( 577 ) ;
PR = PR( index ) ;
gamma = [ gammaH , gammaH, gammaN , gammaN ] ;
```

```
R = [ RH , RH , RN , RN ] ;
Tc = [ TcH , TcH , TcN , TcN ] ;
Cf = sqrt( ((2*gamma.^2)./(gamma-1)).*(2./(gamma+1)).^((gamma+1)./
(gamma-1)).*(1-(1./PR).^((gamma-1)./gamma)) ) + (1./PR).*epsa ;
Cf(1) = sqrt( ((2*gamma(1).^2)./(gamma(1)-1)).*(2./
(gamma(1)+1)).^((gamma(1)+1)./(gamma(1)-1)) ) ;
Cf(3) = sqrt( ((2*gamma(3).^2)./(gamma(3)-1)).*(2./
(gamma(3)+1)).^((gamma(3)+1)./(gamma(3)-1)) ) ;
cstar = sqrt( gamma.*R.*Tc )./( gamma.*sqrt((2./(gamma+1)).^((gamma
+1)./(gamma-1)) )) ;
c = Cf.*cstar ;
Ispa = c ./ g ;
mdot = Thrust./c ;
mp = Itot./(Ispa.*g) ;
tv(1:2) = mp(1:2)/1020 ;
tv(3:4) = mp(3:4)/(Ptank/(RN*TcN)) ;


properties = [ "Expansion Ratio" ; "Specific Impulse [s]" ; "Mass Flow
 Rate [kg/s]" ; "Propellant Mass [kg]" ; "Tank Volume [m^3]" ] ;
ColumnNames = [ "Properties" , "Hydrazine Ideal" , "Hydrazine Real"
 , "Cold Gas Ideal" , "Cold Gas Real" ] ;
Values = [ epsa ; Ispa ; mdot ; mp ; tv ] ;
Output = [ ColumnNames ; properties , Values ]  ;
Output(2,2) = "Inf." ;
Output(2,4) = "Inf." ;
disp( Output )

Ptank = linspace( 1e6 , 40e6 , 1e4 ) ;
tv = mp(4)./(Ptank/(RN*TcN)) ;
figure
plot( Ptank.*1e-6 , tv )
xlabel( 'Tank Pressure [MPa]' )
ylabel( 'Tank Volume [m^3]' )
```

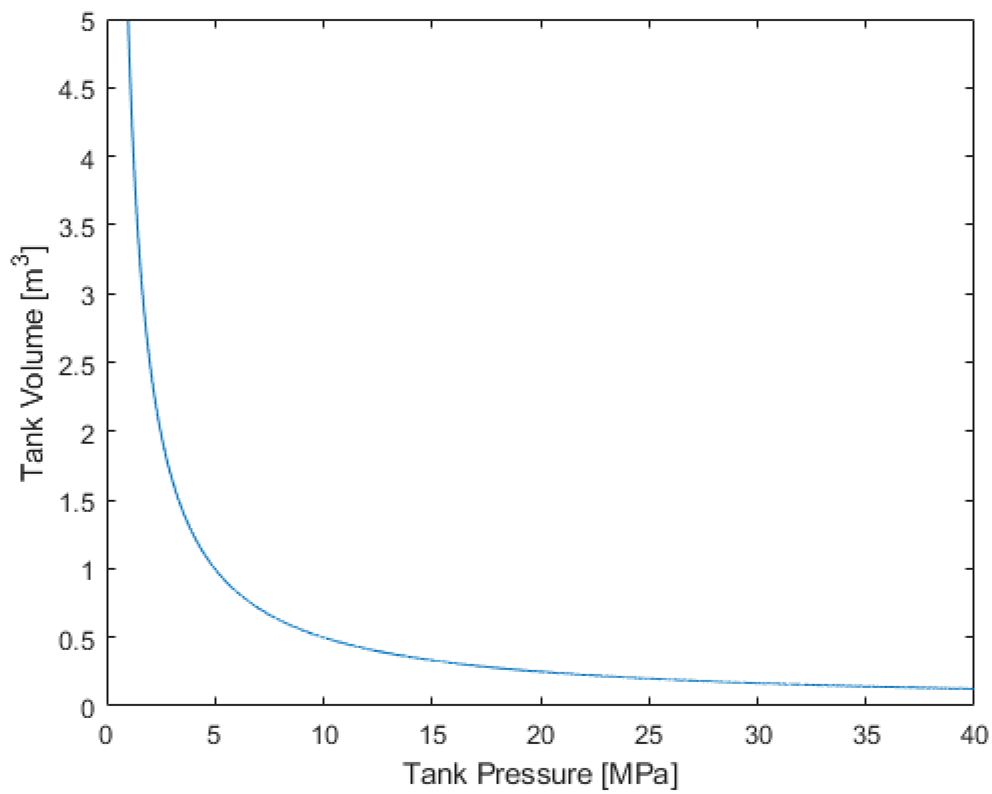
```
  Columns 1 through 3

    "Properties"               "Hydrazine Ideal"    "Hydrazine Real"
    "Expansion Ratio"          "Inf."               "13.38995"
    "Specific Impulse …"     "231.2865"           "182.9699"
    "Mass Flow Rate [k…"     "0.01762953"         "0.02228493"
    "Propellant Mass […"     "17.62953"           "22.28493"
    "Tank Volume [m^3]"        "0.01728385"         "0.02184797"

  Columns 4 through 5

    "Cold Gas Ideal"    "Cold Gas Real"
    "Inf."              "9.012483"
    "80.50426"          "72.83891"
    "0.05064915"        "0.05597931"
    "50.64915"          "55.97931"
    "0.2256419"         "0.2493878"
```


Coefficient of Thrust
Pressure Ratio
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
0
200
400
600
800
1000
1200
1400
1600
1800
2000


Specific Impulse
Area Ratio
210
200
190
180
170
160
150
140
130
120
0
20
40
60
80
100
120
140



Specific Impulse
Area Ratio



Tank Volume [m3]
Tank Pressure [MPa]

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