

**Problem-1**

To(K)	303
cp(kJ/kg-K)	1.003413793
T(K)	288
V^2(m^2/s^2)	30102.41379
V(m/s)	173.500472

$$h_0 = h + \frac{V^2}{2}$$

Ru(kJ/kmc)	8.314
M(kg/kmo)	29
R(kJ/kg-K)	0.286689655
gamma	1.4

**Problem-2**

cp(kJ/kg-K)	5.180738806
T1(K)	283
V1(m/s)	180
T2(K)	263
(h1-h2)(J/kg)	103614.7761
V2^2/2 (m/s)^2	119814.7761
V2(m/s)	489.5197159

$$h_1 + \frac{V_1^2}{2} = h_2 + \frac{V_2^2}{2}$$

Ru(kJ/kmc)	8.314
M(kg/kmo)	4
R(kJ/kg-K)	2.0785
gamma	1.67

**Problem-3**

V(m/s)	250
T(K)	308
p(kPa)	150
D(m)	0.2
dD/dx	0.1
dA/dx(m)	0.031415927
R(air)(kJ/kg-K)	0.286689655
gamma	1.4
c(m/s)	351.5971833
M	0.711040964
A(m^2)	0.031415927
dV/dx(/s)	-505.6422105
dp/dx(kPa/m)	214.7394568
rho(kg/m^3)	1.698746286
drho/dx(kg/m^4)	1.737085023

$$\frac{dA}{dx} = \frac{\pi}{4} 2 D \frac{dD}{dx}$$

$$\frac{dV}{V} = - \frac{dA}{A} \frac{1}{(1 - M^2)}$$

$$\Rightarrow \frac{dV}{dx} = - \frac{V}{A} \frac{dA}{dx} \frac{1}{(1 - M^2)}$$

$$\frac{dp}{dx} = - \frac{\rho}{V} \gamma M^2 \frac{dV}{dx}$$

$$\frac{d\rho}{dx} = - \frac{\rho}{V} M^2 \frac{dV}{dx}$$

**Problem-4**

n(Degree of freedom)	3 gamma	1.666666667	Ru (kJ/k-mol-K)	8.314
n(Degree of freedom)	5 gamma	1.4	T(K)	288
n(Degree of freedom)	6 gamma	1.333333333		

Gas	M(kg/kmol)	R(kJ/kg-l gamma)	C(m/s)
H2	2	4.157	1.4 1294.64
He	4	2.0785	1.666666667 998.839
N2	28	0.2969	1.4 346.008

T_He/T_H2	1.68
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**Problem-5**

T(K)	303
delp(Pa)	30
p(kPa)	101
gamma	1.4
R(air)(kJ/kg-K)	0.286689655
c(m/s)	348.7316328
rho(kg/m^3)	1.162697458
delV(m/s)	0.073988324
drho(kg/m^3)	0.000246683
dT/T	8.48656E-05

$$\Delta V = \frac{\Delta p}{\rho C}$$

$$\frac{dp}{d\rho} = \gamma \frac{p}{\rho} = C^2$$

$$\frac{dp}{p} - \frac{d\rho}{\rho} - \frac{dT}{T} = 0$$

dT(K)	0.025714286
<b>Problem-6</b>	
speed(km/h)	1500
speed(m/s)	416.6666667
T(K)	213
gamma	1.4
R(air)(kJ/kg-K)	0.286689655
c(m/s)	292.3881926
M	1.425046145
<b>Problem-7</b>	
speed(km/h)	800
speed(m/s)	222.2222222
T(K)	288
gamma	1.4
R(air)(kJ/kg-K)	0.286689655
c(m/s)	339.9901013
M	0.6536138
T(K)	229
speed(m/s)	198.1568015
speed(km/h)	713.3644853
<b>Problem-8</b>	
T(K)	173
gamma	1.4
R(air)(kJ/kg-K)	0.286689655
c(m/s)	263.5075606
p(kPa)	20
rho(kg/m^3)	0.403247673
A(m^2)	1.4884
M	3.5
V(m/s)	922.276462
emdot(kg/s)	553.5446485
<b>Problem-9</b>	
A1(m^2)	0.0005
V(m/s)	100
p(kPa)	680
T(K)	303
R(air)(kJ/kg-K)	0.286689655
rho(kg/m^3)	7.828062094
emdot(kg/s)	0.391403105
gamma	1.4
c(m/s)	348.7316328
M	0.286753453
1+(gama-1)/2*M^2	1.016445509
p_0/p	1.058752269
p_0(kPa)	719.951543
1+(gama-1)/2	1.2
A1/A*	2.119336455
A*(m^2)	0.000235923
A2(m^2)	0.00038
A2/A*	1.610695706
M1	0.3937189
M2	1.943441269

**Problem 10**

$$\Rightarrow \frac{p_0}{p} = \left[ 1 + \left( \frac{\gamma - 1}{2} \right) M^2 \right]^{\frac{\gamma}{\gamma - 1}}$$

$$\Rightarrow \frac{A}{A^*} = \frac{1}{M} \left[ \frac{1 + \left( \frac{\gamma - 1}{2} \right) M^2}{1 + \left( \frac{\gamma - 1}{2} \right)} \right]^{\frac{\gamma + 1}{2(\gamma - 1)}}$$

M_guess	0.39372	A/A*	1.611
1+(gama-1)/2*M^2	1.031		
error in A/A*	-0.00013		