Problem 1

- Method 1 – integral()

MATLAB Code :

```
cv = @(T) 700 + 0.35*T - 2e-4*T.^2
T1 = 320
T2 = 820
du_1 = integral(cv,320,820)
disp(du_1)
```

Obtained Ans - 4.1518e+05

- Method 2 – trapz()

Choosing N grid points :

MATLAB Code :

```
cv = @(T) 700 + 0.35*T - 2e-4*T.^2
T1 = 320
T2 = 820
N = 1000
T = linspace(320,820,N)
du_2 = trapz(T,cv(T))
disp(du_2)
```

Obtained Ans - 4.1518e+05

- Numerical results

$\Delta u = \text{int}(700 + 0.35T - 2 \times 10^{-4} T^2)$

$F(T) = 700T + 0.175T^2 - 32 \times 10^{-4} T^3$

$F(820) = 574000 + 117670 - 36757.87 = 654912.13$

$F(320) = 224000 + 17920 - 2184.53 = 239735.47$

$\Delta u = F(820) - F(320)$

$\Delta u = 654912.13 - 239735.47 = 415176.66$ J/kg

$\Delta u = 654912.13 - 239735.47 = 415716.66$ J/ kg

- Minimum Grid Resolution

MATLAB Code :

```
cv = @(T) 700 + 0.35*T - 2e-4*T.^2;
T1 = 320;
T2 = 820;
uexact = 415176.66;  % from numerical calculation
Ns = [3 4 5 10 20 50 100 200 500 1000 2000];
for N = Ns
   T = linspace(320,820,N);
   un = trapz(T,cv(T));
   err = abs(un - uexact)/uexact * 100;
   fprintf("N = %4d   Error = %.5f%%\n", N, err)
end
```

Running the code we can clearly see that for N = 5 error becomes less than 0.1 % .

Minimum grid resolution is N = 5