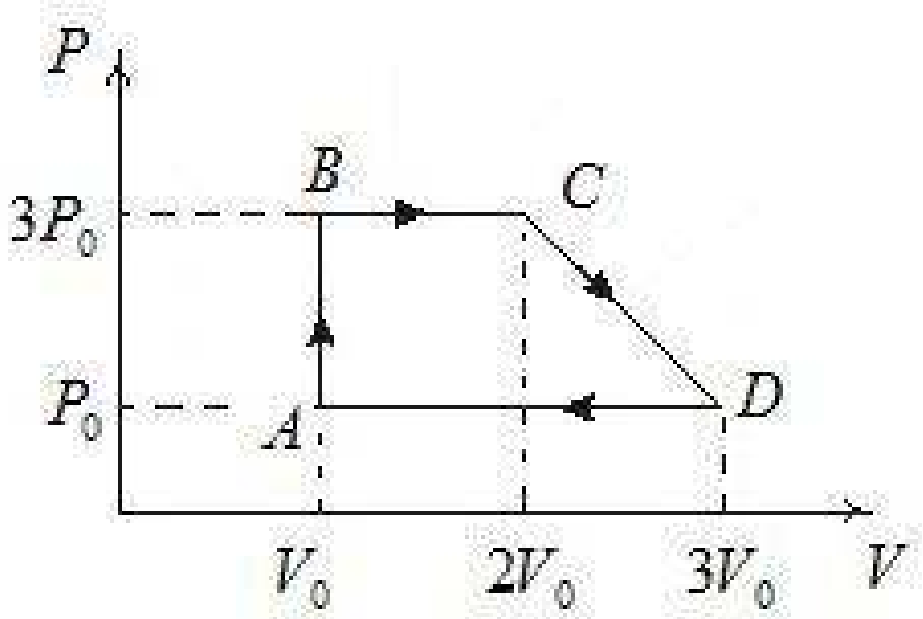
Thermodynamics Problem’s

Question: One mole of an ideal monoatomic gas is taken round the cyclic process ABCDA as shown in figure.

A)Work done by the gas
b Heat absorbed by the gas in AB and BC
c. Heat in process CD
d. Find the temperature at C and D
e. Maximum temperature attained by the gas during the cycle
f. Net change in the internal energy and the heat



Solution

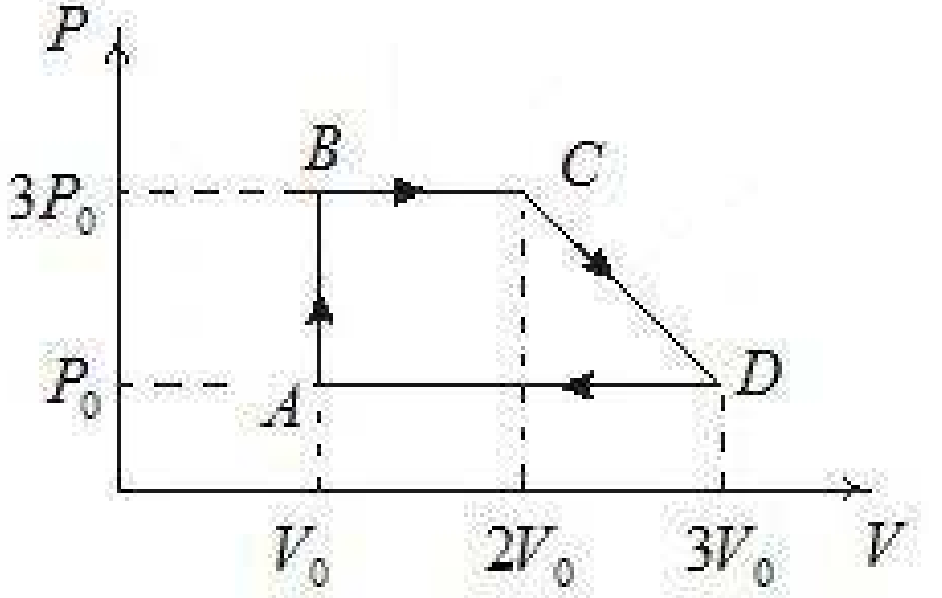
For monoatomic gas

Cp=5R/2

Cv=3R/2

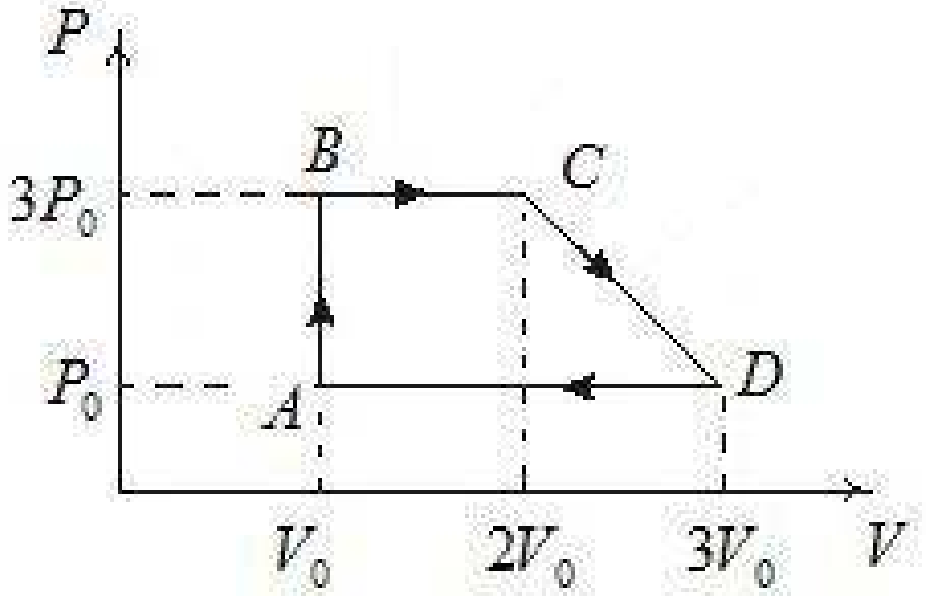
a) Workdone by the gas = Area enclosed by the curve ABCDA

$=3P_0V_0$



Solution continued

- Heat absorbed the gas in AB
  $Q_{AB} = C_V(T_B - T_A)$
  $= (3R/2)(3P_0V_0/R - P_0V_0/R)$
  $= 3P_0V_0$
  Heat absorbed the gas in BC
  $Q_{BC} = C_P(T_C - T_B)$
  $= (5R/2)(6P_0V_0/R - 3P_0V_0/R)$
  $= 15P_0V_0/2$



Solution continued

- Heat rejected in DA

  $Q_{DA} = C_P (T_A - T_D)$

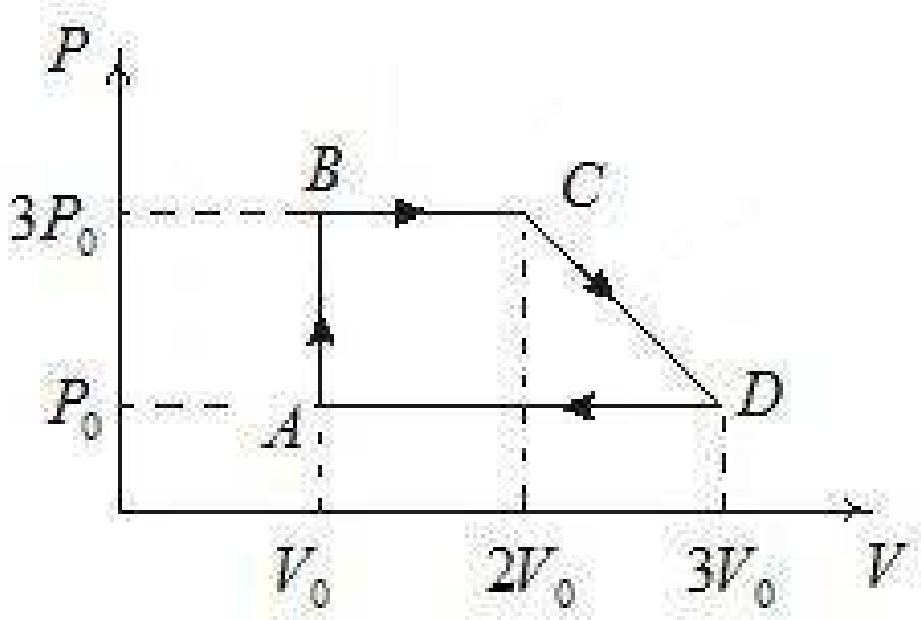
  $= -5P_0V_0$

  Now for the cycle process

  $Q_{AB} + Q_{BC} + Q_{CD} + Q_{DA} = W$

  So

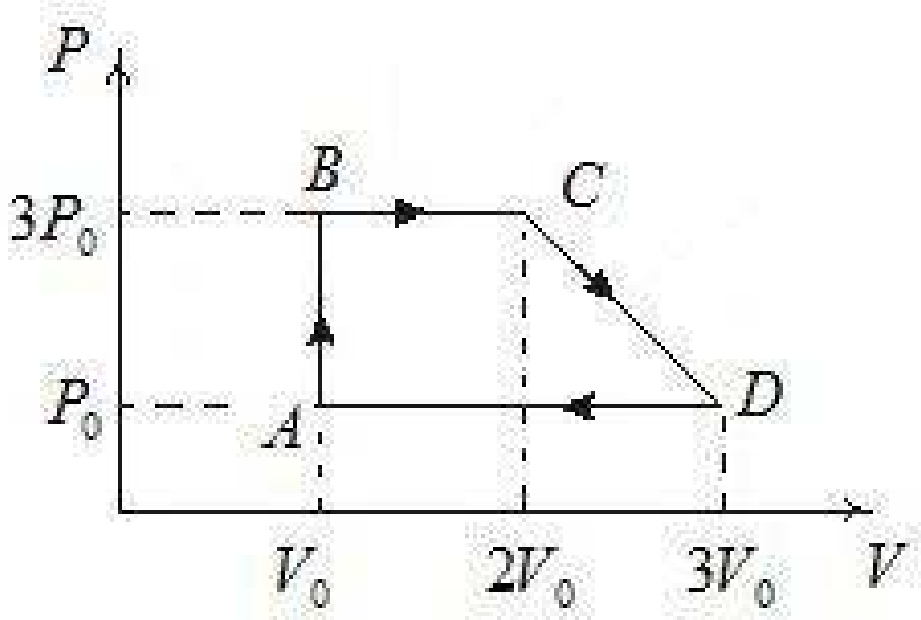
  $Q_{CD} = -5P_0V_0/2$



Solution continued

- from diagram and PV=RT

$T_C = 6P_0V_0/R$
$T_D = 3P_0V_0/R$



Solution Continued

- Max temperature will be on the slope CD

  Equation of Slope CD as Coordinated system
  y=mx +c
- Taking the values for C and D,we get
- $P=-(2P_0/V_0)\ V + 7P_0$
  Now PV=RT

  So
  $RT= -(2P_0/V_0)V2 + 7P_0$

  For max
  dT/dV should be zero

  So $RdT/dV=-4P_0\ V/V_0 +7$
  $V=7V_0\ /4$
  $Tmax= 49_{P_0V_0}/4R$

  f. ΔU=0
  Net heat=3P0V0