One and one half moles of an ideal monatomic gas expand adiabatically, performing 7500 J of work in the process. What is the change in temperature of the gas during this expansion?

Sol) No. of moles of monoatomic gas n = 1.5

Work done by the gas = 7500 J

The definition of an adiabatic process is that heat transfer to the system is zero, $\delta Q = 0$. Then, according to the first law of thermodynamics,

$$dU + \delta W = \delta Q = 0$$

where dU is the change in the internal energy of the system and δW is work done by the system. Any work (δW) done must be done at the expense of internal energy U, since no heat δQ is being supplied from the surroundings. Pressure-volume work δW done by the system is defined as

Thus $dU = -\delta W = 7500$ J

But $U = \alpha nRT$

Where α comes from number of degrees of freedom

And α = 3/2 for monoatomic gas

Thus $dU = \alpha nRdT = \delta W = 7500$

Here $R = 8.314472\ J \cdot K^{-1} \cdot mol^{-1}$

Or Change in temperature $dT = 7500/\ \alpha nR =(7500*2)/(3*1.5*8.314)$

Or $dT = 400.9$ deg C