2-e-3

One liter of an ideal gas with a pressure of 1 atmosphere and a temperature of $298\,K$ is expanded isothermally and reversibly to a volume of 10 litres. Subsequently, it is heated to $500\,K$, compressed to $1\,l$ and cooled down to $25°C$ so that the gas returns to the initial state. What is the total change of the internal energy U of the gas?

Answer: $\Delta U = 0\ J$

The internal energy does not change. U is a state function, so the total internal energy of the gas has not changed if the system returns to the same state. At the states the system goes through during the processes the system has a different internal energy but in the end all energy differences cancel.