Homework 25.

First law of thermodynamics

Problems:

1. A cylinder contains an ideal gas under a movable piston. The gas receives 800 J of heat. During the process, the piston rises and the gas expands, doing work against the external pressure. At the end of the process, measurements show that the internal energy of the gas increased by only 300 J.

a) How much work did the gas perform?

b) Where did the rest of the supplied heat energy go?

c) If the piston had been locked so the gas could not expand, what would the change in internal energy have been?

2. A gas undergoes two processes:

Process 1: The gas absorbs 500 J of heat and expands, doing 200 J of work.

Process 2: The gas is then compressed, and 150 J of work is done *on* the gas. During this compression, the gas loses 100 J of heat to the surroundings.

a) Find the change in internal energy during each step.

b) What is the total change in internal energy after both steps?

c) Is the final temperature higher or lower than the initial temperature?

3. A student performs an experiment with gas and records:

- Heat added to gas: **400 J**
- Gas volume decreases because the piston is pushed inward
- Internal energy increases by **550 J**

a) Was work done by the gas or on the gas?

b) Calculate the magnitude of the work.

c) Explain how the internal energy can increase by more than the heat supplied.