Name:
For full credit, make your work clear. Don’t forget to show the formulas you use, all the essential steps, and results with correct units and correct number of significant figures.

Molar masses (g/mol): H=1, He=4, C=12, N=14, O=16.
Constants: \( N_A = 6.02 \times 10^{23}/\text{mol} \), \( R = 8.314 \text{ J/mol·K} \), \( k = 1.38 \times 10^{-23} \text{ J/K} \).

1. (5) There are 1.20 grams of helium occupying 4.0-liters of volume in a container fitted with a movable piston, initially at a temperature of 22.0 °C. The gas undergoes an isothermal compression down to a volume of 1.0 liter.
   a) (2) The work done by the gas must be
      a. negative  b. zero  c. positive  d. no way to know.
   
   b) (2) The heat absorbed by the gas must be
      a. negative  b. zero  c. positive  d. no way to know.
   
   c) (1) The change in internal energy of the gas must be
      a. negative  b. zero  c. positive  d. no way to know.

2. (5) An ideal Carnot heat engine burns fuel at a temperature of 1080 °C, which produces heat input to the engine at a rate of 88 kW. The mechanical power output is 66 kW.
   a) (2) What is the efficiency of the engine?
   
   b) (3) At what temperature does it exhaust waste heat to the environment?