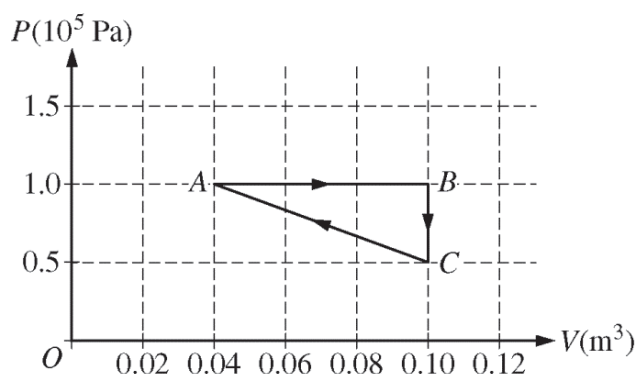


PHYSICS 2**Section II****4 Questions****Time—90 minutes**

Directions: Questions 1 and 4 are short free-response questions that require about 20 minutes each to answer and are worth 10 points each. Questions 2 and 3 are long free-response questions that require about 25 minutes each to answer and are worth 12 points each. Show your work for each part in the space provided after that part.



1. (10 points, suggested time 20 minutes)

Two moles of a monatomic ideal gas are enclosed in a cylinder by a movable piston. The gas is taken through the thermodynamic cycle shown in the figure above. The piston has a cross-sectional area of $5 \times 10^{-3} \text{ m}^2$.

- (a)
- Calculate the force that the gas exerts on the piston in state *A*, and explain how the collisions of the gas atoms with the piston allow the gas to exert a force on the piston.
 - Calculate the temperature of the gas in state *B*, and indicate the microscopic property of the gas that is characterized by the temperature.
- (b)
- Predict qualitatively how the internal energy of the gas changes as it is taken from state *A* to state *B*. Justify your prediction.
 - Calculate the energy added to the gas by heating as it is taken from state *A* to state *C* along the path *ABC*.
- (c) Determine the change in the total kinetic energy of the gas atoms as the gas is taken directly from state *C* to state *A*.