

73. The net work may be computed as a sum of works (for the individual processes involved) or as the “area” (with appropriate  $\pm$  sign) inside the figure (representing the cycle). In this solution, we take the former approach (sum over the processes) and will need the following fact related to processes represented in  $pV$  diagrams:

$$\text{for straight line} \quad \text{Work} = \frac{p_i + p_f}{2} \Delta V$$

which is easily verified using the definition Eq. 19-25. The cycle represented by the “triangle”  $BC$  consists of three processes:

- “tilted” straight line from  $(1.0 \text{ m}^3, 40 \text{ Pa})$  to  $(4.0 \text{ m}^3, 10 \text{ Pa})$ , with

$$\text{Work} = \frac{40 \text{ Pa} + 10 \text{ Pa}}{2} (4.0 \text{ m}^3 - 1.0 \text{ m}^3) = 75 \text{ J}$$

- horizontal line from  $(4.0 \text{ m}^3, 10 \text{ Pa})$  to  $(1.0 \text{ m}^3, 10 \text{ Pa})$ , with

$$\text{Work} = (10 \text{ Pa}) (1.0 \text{ m}^3 - 4.0 \text{ m}^3) = -30 \text{ J}$$

- vertical line from  $(1.0 \text{ m}^3, 10 \text{ Pa})$  to  $(1.0 \text{ m}^3, 40 \text{ Pa})$ , with

$$\text{Work} = \frac{10 \text{ Pa} + 40 \text{ Pa}}{2} (1.0 \text{ m}^3 - 1.0 \text{ m}^3) = 0$$

Thus, the total work during the  $BC$  cycle is  $75 - 30 = 45 \text{ J}$ . During the  $BA$  cycle, the “tilted” part is the same as before, and the main difference is that the horizontal portion is at higher pressure, with  $\text{Work} = (40 \text{ Pa})(-3.0 \text{ m}^3) = -120 \text{ J}$ . Therefore, the total work during the  $BA$  cycle is  $75 - 120 = -45 \text{ J}$ .