24. Two blocks of steel, the first of mass 1 kg and the second of mass 2 kg, are in thermal equilibrium with a third block of aluminum of mass 2 kg that has a temperature of 400 K. What are the respective temperatures of the first and second steel blocks?
    (A) 400 K and 200 K   (B) 200 K and 400 K   (C) 400 K and 400 K
    (D) 800 K and 400 K   (E) None of the above

25. An ideal gas may be taken from one state to another state with a different pressure, volume, and temperature along several different paths. Quantities that will always be the same for this process, regardless of which path is taken, include which of the following?
       I. The change in internal energy of the gas
       II. The heat exchanged between the gas and its surroundings
       III. The work done by the gas
    (A) I only   (B) II only   (C) I and III only   (D) II and III only   (E) I, II, and III

26. A square steel plate with sides of length 1.00 m has a hole in its center 0.100 m in diameter. If the entire plate is heated to such a temperature that its sides become 1.01 m long, the diameter of the hole will be
    (A) 0.090 m   (B) 0.099 m   (C) 0.100 m   (D) 0.101 m   (E) 0.110 m

33. The theoretical (Carnot) efficiency of a heat engine operating between 600°C and 100°C is:
    (A) 16.7%   (B) 20.0%   (C) 42.7%   (D) 57.3%   (E) 83.3%
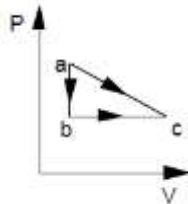
34. A gas can be taken from state a to c by two different reversible processes, $a{\Rightarrow}c$ or $a{\Rightarrow}b{\Rightarrow}c$. During the direct process $a{\Rightarrow}c$, 20.0 J of work are done by the system and 30.0 J of heat are added to the system. During the process $a{\Rightarrow}b{\Rightarrow}c$, 25.0 J of heat are added to the system. How much work is done by the system during $a{\Rightarrow}b{\Rightarrow}c$?
    (A) 5.0 J   (B) 10.0 J   (C) 15.0 J   (D) 20.0 J   (E) 25.0 J

37. Which of the following is always true for an isothermal process of an ideal gas?
    (A) The internal energy does not change.
    (B) No heat flows into or out of the system.
    (C) The pressure does not change.
    (D) The volume does not change.
    (E) No work is done by or on the system.

38. The average speed of the atoms of a gas at 100 K is 200 m/s. What would most nearly be the average speed of the atoms at 300 K?
    (A) 67 m/s   (B) 140 m/s   (C) 200 m/s   (D) 350 m/s   (E) 600 m/s

40. A heat engine takes in 200 J of thermal energy and performs 50 J of work in each cycle. What is its efficiency?
    (A) 50 %   (B) 40 %   (C) 25 %   (D) 20 %   (E) 12 %
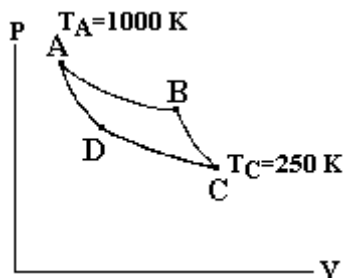
50. A monatomic ideal gas is used as the working substance for the Carnot cycle shown in the figure. Processes A → B and C → D are isothermal, while processes B → C and D → A are adiabatic. During process A → B, there are 400 J of work done by the gas on the surroundings. How much heat is expelled by the gas during process C → D?
    (A) 1600 J   (B) 800 J   (C) 400 J   (D) 200 J   (E) 100 J