Thermodynamics

Choose one answer per question. Circle A, B, C, or D.

1. Two blocks have the same temperature and can exchange energy with each other. What is their net heat transfer at thermal equilibrium?
   A. Zero
   B. Always from the larger block to the smaller one
   C. Always from the smaller block to the larger one
   D. Equal to the sum of their masses

2. A warm cup touches a colder tabletop. In which direction does heat flow spontaneously at first?
   A. In whichever direction has the larger mass
   B. From the tabletop to the cup
   C. From the cup to the tabletop
   D. There is no heat transfer because both objects are solid

3. What is the heat transfer Q across a perfectly insulated system boundary?
   A. Equal to the work done by the system
   B. Zero
   C. Always positive
   D. Always negative

4. Use the convention $\Delta U = Q - W$, with W the work done by a gas. What sign does W have when the gas expands and pushes a piston outward?
   A. The sign is undefined
   B. Negative
   C. Zero for every expansion
   D. Positive

5. What name describes a process in which the system’s temperature is held constant?
   A. Isobaric
   B. Isothermal
   C. Isochoric
   D. Adiabatic

6. A closed gas system absorbs 120 joules of heat and does 35 joules of work. What is the change in internal energy?

A. An increase of 85 joules
B. An increase of 155 joules
C. A decrease of 85 joules
D. An increase of 35 joules

7. A piston does 55 joules of work on a closed gas while 15 joules of heat leave it. How does the gas’s internal energy change?

A. It falls by 70 joules.
B. It rises by 70 joules.
C. It falls by 40 joules.
D. It rises by 40 joules.

8. At a constant pressure of 200,000 pascals, a gas expands by 0.003 cubic meter. How much pressure-volume work does it do?

A. 6 joules
B. 60 joules
C. 600 joules
D. 6,000 joules

9. During a complete cycle, a system absorbs 200 joules of heat and releases 140 joules of heat. What is the net work done by the system?

A. 60 joules
B. 340 joules
C. 140 joules
D. Zero joules

10. A fixed amount of ideal gas expands while its temperature stays constant. If it does positive work, what is true of the heat transfer?

A. The gas’s temperature must rise to balance the work.
B. The gas releases heat equal to the work it does.
C. No heat can be transferred at constant temperature.
D. The gas absorbs heat equal to the work it does.

11. In one cycle, an engine absorbs 240 joules from a hot reservoir and releases 160 joules to a cold reservoir. What is its efficiency?

A. One half
B. Two thirds
C. One third
D. Two fifths

12. A reversible heat engine works between reservoirs at 500 kelvins and 300 kelvins. What is its maximum efficiency?

A. 60 percent
B. 40 percent
C. 20 percent
D. 80 percent

13. A refrigerator removes 220 joules from its cold space while using 55 joules of work. What is its refrigeration coefficient of performance?

A. 5
B. 0.25
C. 3
D. 4

14. Two regions inside an isolated container start at different temperatures and are allowed to reach equilibrium. What happens to the total entropy of the contents?

A. It increases.
B. It decreases.
C. It stays the same because energy is conserved.
D. It must become zero.

15. A 480-kelvin reservoir transfers 480 joules of heat to a 240-kelvin reservoir. Treat both temperatures as constant. What total entropy change do the two reservoirs undergo?

A. An increase of 3 joules per kelvin
B. A decrease of 1 joule per kelvin
C. An increase of 1 joule per kelvin
D. Zero change