

Placement Exam - Basic Principles of Thermodynamics Sample Questions

1. Which of the following statements about ideal gases is incorrect?
 - (a) For an ideal gas contained in an insulated fixed volume tank, pressure is linearly proportional to temperature.
 - (b) The difference between the specific heat at constant pressure, C_p , and the specific heat at constant volume, C_v , is always equal to the ideal gas constant, i.e. $C_p - C_v = R$.
 - (c) For an ideal gas contained in a fixed volume closed tank maintained at constant temperature, its internal energy increases with pressure.
 - (d) For a single component ideal gas, its specific entropy (kJ/kg-K) is uniquely determined provided its pressure and temperature is known.

2. The final pressure at the end of an isentropic compression of air can be calculated if following are known:
 - (a) Initial temperature, initial pressure, initial volume
 - (b) Initial temperature, initial pressure, final volume
 - (c) Initial temperature, initial pressure, final entropy
 - (d) Initial temperature, initial pressure, initial internal energy

3. The value of convection heat transfer is larger for gases as compared to liquids.
 - (a) True
 - (b) False

4. Is Joule-Thomson coefficient positive or negative for an expansion process that results in cooling?
 - (a) Positive
 - (b) Negative

5. A simple compressible substance undergoes a reversible isothermal process in which the pressure increases. The entropy of the substance:
 - (a) increases
 - (b) decreases
 - (c) remains the same

6. Two ideal gases initially at temperature T and pressure P are mixed isothermally and at constant pressure. In the mixing process, the total entropy of the mixture:
 - (a) increases
 - (b) decreases
 - (c) remains the same

7. A 2 m³ rigid tank contains nitrogen gas at 500 kPa and 300 K. Now heat is transferred to the nitrogen in the tank and the pressure of nitrogen rises to 800 kPa. The work done during this process is
- (a) 600 kJ (b) 1000 kJ (c) 500 kJ (d) 0 kJ
8. Air at 20°C and 5 atm is throttled by a valve to 2 atm. If the valve is adiabatic and the change in kinetic energy is negligible, the exit temperature of air will be
- (a) 10°C (b) 14°C (c) 20°C (d) 24°C
9. The pressure of an incompressible liquid is increased from 1 bar to 100 bar in an adiabatic pump. What is the minimum work input required (kJ/kg), assuming a density of the liquid of 1000 kg/m³?
- (a) 0.1 (b) 9.9 (c) 0.099 (d) 10
10. The molar specific volume of an unknown pure gas at a temperature of 200 K and a pressure of 50 bar is 2.9×10^{-4} m³/mol. Determine the compressibility factor of this gas.
- (a) 0.87 (b) 0.92 (c) 1 (d) 1.05

Thermodynamics Sample Questions Key

1. C
2. B
3. B
4. A
5. B
6. C
7. D
8. C
9. B
10. A