Thermodynamics Test – English version

For the ideal gas consider: the universal constant R = 8.31 J/(mol·K), Approximate the value of the melting temperature of ice under normal pressure conditions expressed in the Celsius scale, 0°C, with the value of 273 K in the absolute temperature scale.

Items 1-10 are multiple-choice with a single correct answer, and each is scored with 0.9 points (1 point awarded from start for this section).
Items 11 and 12 are scored with 4.5 points each (1 point awarded from start for this section)
Final score is calculated as: N=0.6N1+0.4N2, unde
N1=score for the first section (items 1-10) +1 point from start,
N2=score for the second section (items 11-12) +1 point from start .
Working time – two hours.

1. The molar mass, μ, of a quantity m of ideal gas containing ν moles is given by the relation:

a) $\mu = m \times \nu$; b) $\mu = m/\nu$; c) $\mu = \nu/m$; d) $\mu = \nu/m^{-1}$.

2. Two objects, with different sizes, masses, and temperatures, are placed in thermal contact. Energy is transferred from:

(a) the larger object to the smaller object; (b) the smaller object to the larger object;

(c) the object with more mass to the one with less; (d) the object at higher temperature to the object at lower temperature.

3. In which thermodynamic process the variation of internal energy for an ideal gas is zero?

a) isobaric; b) isochoric; c) adiabatic; d) isothermal.

4. An ideal gas occupies a volume of 100 cm^3 at 20°C and 100 Pa. The number of moles of gas in the container is:

a) $4.1 \times 10^{-6} mol$; b) $4.1 \times 10^{-2} mol$; c) $6 \times 10^{-5} mol$; d) 0.6 mol

5. During an isochoric process where the gas pressure is increasing, the gas will:

a) receive heat from the environment; b) receive work from the environment;

c) release heat to the environment; d) perform mechanical work.

6. A metal body of 50 g is heated to 200°C and then dropped into a beaker containing 0.4 kg of water initially at 20°C and specific heat of 4180 J/(kg×K). If the final equilibrium temperature of the mixed system is 22°C, the specific heat of the metal is:

a) $-375.7\frac{J}{kgK}$; b) $375.7\frac{J}{kgK}$; c) $0.375\frac{J}{kgK}$; d) $-0.375\frac{J}{kgK}$

7. An ideal gas has, in the initial state, the volume V_1 and the pressure p_1. The gas performs an isothermal expansion and doubles the volume. What is the gas pressure in the final state?

a) $2p_1$; b) $p_1/2$; c) p_1; d) $p_1/4$.

8. For an ideal gas with the adiabatic exponent γ = 1.4, the molar heat at constant volume of is:

a) $\frac{3}{2}R$; b) $\frac{5}{2}R$; c) 3R; d) 2R

9. A heat engine operates in a Carnot cycle with the temperature of the cold reservoir of 127 ^{0}C and the temperature of the hot reservoir of 327 ^{0}C. The value of the ratio $|Q_{release}/Q_{received}|$ is:

a) 2/3; b) 3/2; c) 0.4; d) 2.6

10. The mechanical work performed by υ moles of a diatomic ideal gas ($Cp = 7/2\ R$) during an adiabatic process, carried out between the temperatures T_1 and T_2 has the expression:

a) $\frac{7R}{2}(T_2 - T_1)$; b) $\frac{-5R}{2}(T_2 - T_1)$; c) $\frac{-7R}{2}(T_2 - T_1)$; d) $\frac{5R}{2}(T_2 - T_1)$

11. In a container of volume V=16,62 l there is a quantity of m_1=8 g of Helium ($\mu_{He}=4\cdot10^{-3}$ kg/mol) and ν_2=3 mols of O_2 ($\mu_{O2}=32\cdot10^{-3}$ kg/mol), at temperature t=27°C. Find out:

a) the pressure of the gas mixture;
b) the average molar mass of the gas mixture;
c) the pressure of the gas mixture if all the Oxygen dissociates and the temperature increases 3 times.

12. In a container with adiabatic walls, a diatomic ideal gas expands so that the initial volume (V_1=1 l) increases 32 times. If the initial pressure is p_1=12,8 MPa and the initial temperature is T_1=300K, find out the pressure and temperature in the final state.