Thermodinamic-July 2016

1. Various scales were invented for measuring temperature. One of these is the widely used Fahrenheit scale whose relation with the usual Celsius one is the following: $t_F = \frac{9}{5} t_C + 32$. The temperature with the same values in both scales is: (a) 0 °C; (b) -40 °C; (c) 100 °C.

(7.5 points)

2. An ideal gas expands reversibly from a given initial state through two different processes, one isothermal and the other adiabatic, such that in the final states the volumes are equal and the pressures are p_{izo} si p_{ad}. Choose the right answer from the following alternatives: a) $p_{izo} > p_{ad}$; b) $p_{izo} < p_{ad}$; c) $p_{izo} = p_{ad}$.

(7.5 points)

3. If a certain amount of ideal gas undergoes a reversible transformation in which the pressure varies proportionally to the volume, then it follows that: a) $Tp^{1/2} = k$; b) $T/p^{1/2} = k$; c) $p/T^{1/2} = k$, where k is a certain constant.

(7.5 points)

4. If the temperature of an ideal gas changes from 200 °C to 400 °C, how does the volume change if the pressure and the number of molecules are constant?

a) Increases with 100 %; b) Increases with 42 %; c) Increases with 50 %.

(7.5 points)

5. During a reversible isothermal transformation of an ideal gas, the variation of its internal energy is: a) $\Delta U > 0$; b) $\Delta U < 0$; c) $\Delta U = 0$.

(7.5 points)

6. Let A and B two Carnot engines of which the first interacts with the thermostats T_1 and T_2 ($T_1 < T_2$) and the second with the thermostats T_3 and T_4 ($T_3 > T_4$). Does the coupling of these two engines result in a new Carnot engine? a) Yes, if the mechanical work produced by A is entirely delivered to B; b) Yes, if $T_1 = T_3$ and $T_2 = T_4$; c) Yes, if the thermostats T_1 and T_3 are identical and the heat produced by the first engine is equal, in absolute value, to the heat absorbed by the second engine.

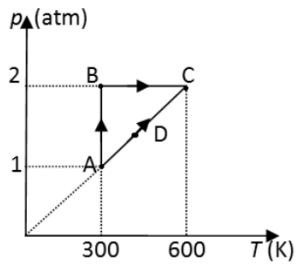
(7.5 points)

7. If the number of molecules in an ideal gas is doubled and the volume is doubled, how does the pressure change if the temperature is held constant?

a) Increases four times; b) Doubles; c) Remains constant.

(7.5 points)

8. One mole of bi-atomic ideal gas ($\gamma = 1.4$) may go from the equilibrium state A to the equilibrium state C in two distinct reversible ways: A→B→C and A→D→C, respectively, as represnted in p -T coordinates in the nearby diagram. It is known that 1 atm ≅ 10^5 Pa, ln 2 = 0.693 and R = 8.314 J/(mol·K). The amount of heat exchanged by the gas with its environment during the process A→D→C is: a) 15.40 kJ; b) 6.24 kJ; c) 12.51 J.



(7.5 points)

9. In the preceding problem, the amount of work made by the gas in the process A→B→C is: a) 0,76 kJ; b) -1,52 J; 15,20 kJ.

(7.5 points)

10. A cylindrical container is closed by a tight, frictionless piston. The vessel contains $\upsilon = 2$ mol of helium ($\mu = 4$ g/mol) at normal temperature and pressure ($p_0 = 10^5$ Pa, $T_0 = 273$ K). The gas density in the initial state is: a) 176 g/m^3; b) 18 Kg/m3; c) 2 g/cm^3.

(7.5 points)

11. The gas from the preceding problem undergoes a reversible transformation during which its pressure remains constant and its absolute temperature doubles. The final volume occupied by the gas is: a) 2,5 m^3; b) 90,8 litri; c) 22,5 cm^3

(7.5 points)

12. A quantity of $\upsilon = 2$ kmol of ideal bi-atomic gas ($C_V = 5R/2$), initially in the sate labeled by 1 and characterized by the parameters $t_1 = 27$ °C and $p_1 = 10^5$ N/m^2, undergoes a cyclic process composed of the following reversible segments: $1 \rightarrow 2$ at V_1 = const.; $2 \rightarrow 3$ with $p_2 = 2p_1$ = const.; $3 \rightarrow 4$ at $V_2 = 2V_1$ = const.; $4 \rightarrow 1$ at p_1 = const. The amount of mechanical work made by the system in a complete cycle is: a) 300 J; b) 5 MJ; 35 kJ.

(7.5 points)