Problem 2 Thermodynamic test

An hypotetical shuttle is launched to investigate the atmosphere (100% CO_2) of two extrasolar planets P_1 and P_2 . The atmosphere is in static thermodynamic equilibrium. When the shuttle is near each planet, a radio probe is launched toward respective planet, in vertical direction (in the direction of the planet`s radius). When the radio probe reaches constant velocity, it starts sending values of the pressure of the atmosphere. In Fig. 3.1 is plotted the atmospheric pressure values (in arbitrary units) as function of the time of descent for the planet P_1. When the probe touches the surface of planet P_1 it sends the value of the temperature $T_0 = 700\,\text{K}$ and the value of the gravitational acceleration $g_0 = 10\,\text{ms}^{-2}$.

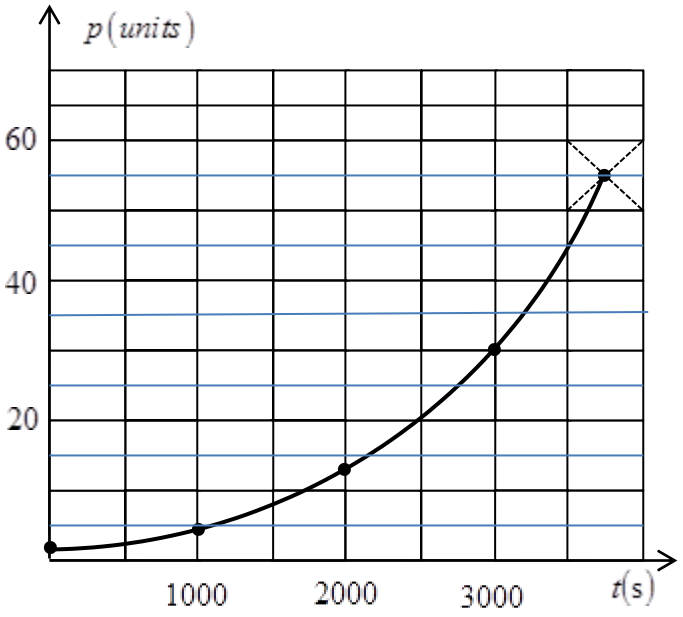


Fig. 3.1.

The gravitational acceleration on each planet is assumed to be constant during uniform descent of the radio probes.

a) Find the altitude h_0 from where the radio probe R_1 starts the uniform descent and thus starts the transmitting information.

b) Find the temperature of planet P_1 at the altitude $h = 39.6\,\text{km}$. You know: The universal gas constant $R = 8.3\,\text{J/molK}$; the molar mass of CO_2, $\mu = 44\,\text{g/mol}$.

c) In Fig. 3.2.was plotted the atmospheric pressure values (in arbitrary units) as a function of time of descent for the planet P_2 atmosphere. When the probe touched the surface of the planet P_2, it sends the value of the temperature $T_0 = 750\,\text{K}$ and respectively the value of gravitational acceleration $g_0 = 8\,\text{ms}^{-2}$

Draw the following dependency graphs for $p = f(h)$ and $T = f(h)$ in the CO_2 atmosphere of the planet P_2.

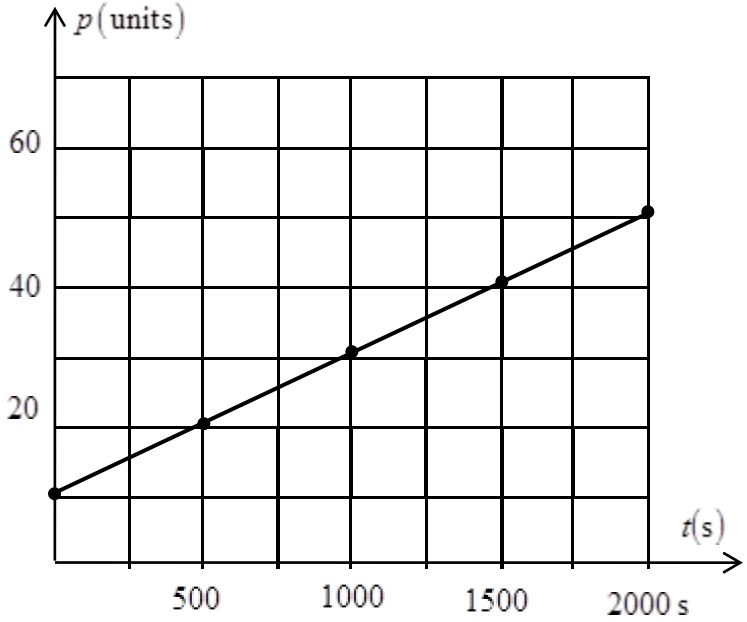


Fig. 3.2.