Remembering Astrophysicist R. Emden: Winter heating

EDVCATIO PHYSICORVM
SIC ITVR AD ASTRA
QVO NON ASCENDAM ?

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Letter to the editor

An attempt has been made to teach physics through following two diagrams; the first one contains subject material and a question based on them. The second one displays the answer as well. Schwartz space and functions. Finally, we investigate the discontinuity of the wave functions by considering that they are into the domain of the position and momentum operators or not.

Figure 1

Question: Eminent astrophysicist R. Emden had asked "*Why do we have winter heating?*" What is the rationale for our comfort? Initially the temperature T_1 in the room is about 0°C, and once the woods are lighted the air in the cabin gets warmer (T_2~20°C), it expands, and a part moves out through small openings around the doors and windows in the adiabatic walls, so that the mass of air in the cabin changes from m_1 to m_2; the volume V of the cabin and the air pressure P, however, remain constant; P is atmospheric pressure. Pick up true and false statements as far as air of the cabin is concerned:

A) Internal energy increases

B) Internal energy decreases

C) Internal energy does not change

D) It is warmer

Answer:

The internal energy $U = mC_VT$ of the air is proportional to its mass m and its absolute temperature T; C_V is the specific heat at constant volume - a constant for an ideal gas. Internal energy can be evaluated using

$$PV = \frac{m}{\mu}RT; n = \frac{m}{\mu}. \quad (1)$$

Here R is the gas constant while μ is its molar mass and n is the number of mole of the air. As the pressure in the cabin remains equal to the outside atmospheric pressure and the volume of the room does not change, there is change in the air mass only, we obtain.

$$m_1T_1 = m_2T_2 = \frac{PV\mu}{R} = constant. \quad (2)$$

Therefore, after the firewood is burned, the internal energy of the air in the cabin really does not change. Thus, we heat our buildings in winter to make energy available at a higher temperature, as an individual's feeling of comfort or discomfort in the room depends primarily on the relationship between room temperature and his body temperature. Thus, C and D are correct.