

Answer on Question 58125, Physics, Molecular Physics | Thermodynamics

Question:

9. The first law of thermodynamics may be written in the form $\Delta U = \Delta Q + \Delta W$, where the symbols have their usual meaning. Which of the following is correct for the case of an isothermal expansion of an ideal gas?

- a) $\Delta W > 0$
- b) $\Delta W = 0$
- c) $\Delta U = 0$
- d) $\Delta U > 0$

Solution:

An isothermal process is a change of a thermodynamic system, in which the temperature remains constant. We know that for an ideal gas the internal energy is proportional to the temperature. Therefore, there is no change in the internal energy of the gas during an isothermal process. The first law of thermodynamics then becomes:

$$\Delta U = 0 = \Delta Q + \Delta W,$$

$$\Delta Q = -\Delta W.$$

It means that the energy change associated with heat upon an isothermal expansion of an ideal gas is the negative of the work. So, the correct answer is c) $\Delta U = 0$.

Answer:

- c) $\Delta U = 0$

10. Which statement about internal energy is correct:

- a) The internal energy of a system can be increased without transfer of energy by heating.
- b) The internal energy depends only on its temperature.
- c) When the internal energy of a system is increased, its temperature always rises.

d) When two system have the same internal energy, they must be at the same temperature

Solution:

Let's write the first law of thermodynamics:

$$\Delta U = Q + W.$$

From this equation we can see, that internal energy U can be increased without transfer of heat energy Q to it, by the work done on it. Thus, the correct answer is a).

Answer:

a) The internal energy of a system can be increased without transfer of energy by heating.