Thermal physics

Thermal physics, or thermodynamics, is a branch of physics that examines the relationships between heat, temperature, and pressure. Originating in the 19th century, thermal physics was instrumental in understanding and enhancing the efficiency of steam locomotives, a cornerstone of the Industrial Revolution.

Thermal physics is grounded in two principal laws: (1) the conservation of energy, and (2) the increase of entropy in the universe.

The first law, also known as the law of energy conservation, asserts that energy can neither be created nor destroyed; it can only be transformed from one form to another. For instance, the combustion of coal in a steam locomotive triggers the release of heat energy, which is then harnessed to propel the train.

The second law of thermal physics introduces the concept of entropy, a measure of disorder or randomness in a system. According to this law, the entropy of the universe must always increase. Pre-combustion, coal contains a high amount of energy alongside low entropy. Upon burning, this energy dissipates as heat, escalating the entropy or disorder in the surrounding environment. Although we are bound to this increase in entropy, we can utilize a portion of the liberated energy to perform meaningful work—for example, driving a steam locomotive.

These fundamental principles of thermal physics explain not only the workings of historical steam engines but also inform modern technology and our understanding of energy systems in the universe.