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THEORETICAL PRINCIPLES AND BASE CRITERIA FOR MEASURING THE TEMPERATURE OF A SUBSTANCE

Annotation: the degree of heating is described, which is determined by the internal kinetic energy generated by the thermal motion of molecules through the temperature of the body. In practice, it will be possible to measure the temperature of bodies only with the help of comparing the heating of one with respect to the other. State pointers of one of the physical properties that depend on temperature and are easily measured are also used when measuring the temperature of bodies.

Key coils: environment, substance, temperature, kinetic energy, heating, electrical properties

Introduction

Temperature is an important parameter of biological and technological processes, which in practice has to be handled with both low and high temperatures [1]. Through the temperature of the body, the degree of heating is described, which is determined by the internal kinetic energy generated by the thermal motion of the molecules. In practice, it will be possible to measure the temperature of bodies only with the help of comparing the heating of one with respect to the other. State pointers of one of the physical properties that depend on temperature and are easily measured are also used when measuring the temperature of bodies.

Materials and methods:

This includes empirical methods such as modeling, fact-finding, experiment, description and observation, as well as theoretical methods such as logical and historical methods, abstraction, deduction, induction, synthesis and analysis, as well as methods of heuristic strategies. The research materials are: scientific facts, the results of previous observations, surveys, experiments and tests; means of idealization and rationalization of the scientific approach.

The bond between the average kineticenergy of molecules and the ideal gas temperature is expressed by the formula [1]:,

$$E = \frac{3}{2} KT \qquad (1)$$

where K is the Boltzmann constant, K=1,380·10-^{23} J.; T – body absolute temperatur, K.

If the temperature of the bodies is different, an equalization of energies occurs when they are tangled together; an object with higher temperatures and, hence, more kinetic energy in its molecules gives its heat (energy) to a lower temperature and, consequently, to an object whose molecules have less kinetic energy. Thus, temperature is a parameter describing both qualitative and quantitative aspects of heat exchange, heat transfer processes. But if the temperature cannot be measured directly, it will also be possible to determine it by some other physical parameter that depends on the temperature in one value. Temperature-dependent parameters include volume, length, electrical resistance, thermoelectric conducting force, energetic clarity of radiation, etc [2].

Results and discussion:

The instrument measuring temperature was first recommended by Galileo in 1598. Then thermometer was developed by Lomonosov and Fahrenheit [2]. To find the numerical value of the measured temperature, it is necessary to set a scale of temperatures, that is, select the number head and the unit of measurement of the temperature range. A series of signs in the temperature range bounded by the boiling and melting points of chemically pure substances that are easily recovered (the main rapper and base) form a temperature scale. These temperatures are given values t` and t``. Then the unit of Measure [3]:

$$1\ градус = \frac{t'' - t'}{n} \tag{2}$$

here: t` and t``- easy-to-recover fixed temperatures; n-t``, t` the temperature range between the base points is a divisible integer.

Equation of temperature scale:

$$t = t` + \frac{v - v'}{v'' - v'} \cdot (t`` - t`) \tag{3}$$

were: t` and t`` - base points of the substance (760 mm wire.who.at pressure and acceleration of the weight force 980,665 cm/s$^2$, the melting temperature of the moss and the boiling temperature of the water); v` and v`` - t, t`` the volume of a substance (liquid) at temperatures; v-t the volume of a substance (liquid) at temperature.

In nature, volumetric expansion and temperature in all cases do not contain interlinear connected fluids. The physical nature of a liquid substance (Mercury, alcohol, etc.) inside a thermometer has its effect in measuring temperature. That is why, with the development of Science and technology, the need arose to create a single temperature scale that was not associated with a single property of a substance put into a thermometer. In 1848, the English physicist Kelvin proposes to construct a new temperature scale based on the second law of thermodynamics. Equation of the thermodynamic temperature scale [3]:

$$T = \frac{Q}{Q_{100} - Q_0} \cdot 100\% \tag{4}$$

where: Q_{100} and Q_0 are the amounts of heat corresponding to the boiling and melting temperatures of water; Q is the amount of heat corresponding to the temperature.

The decisions of the XI international conference on measurements and weights of 1960 and GOST 8550-61 envisage the use of two types of temperature scales, the thermodynamic scale measured by the Kelvin degree (K) unit of measurement and the International practical scale measured by the Celsius degree (0s) unit of measurement. The bottom point on the Kel'vin thermodynamic scale is the absolute zero point (R), and the only ecmperimental principal point is the triple point of water. The numerical value of this point is 273.15 K. The triple point of water, which is the equilibrium point in the phases of water's moz, liquid gas, stands 0.01 K higher than the Moz melting point. Thermodynamic temperature is represented by the letter T, and number values by K.

Table 1.

Main base points of IPTS-68

№	Phase equilibrium states	Accepted value at international practical temperatures	
		T_{68} ,K	t_{68} , oC
1	2	3	4
1.	Balance between the solid, liquid and gaseous phases of hydrogen (tertiary point of hydrogen)	13,81	-259,34
2.	Liquid and gaseous phases of hydrogen at a pressure equal to 33330.6 Pa (25/76 normal atmospheric pressure)	17,042	-256,108
3.	Balance between liquid and gaseous phases of hydrogen (boiling point of hydrogen)	20,28	-252,87
4.	Balance between the liquid and gaseous phases of neon (boiling point of neon)	27,102	-246,048
5.	Balance between the solid, liquid and gaseous phases of oxygen (boiling point of oxygen)	54,381	-218,789
6.	Balance between liquid and gaseous phases of oxygen (boiling point of oxygen)	90,188	182,962

7.		Balance between the solid, liquid and gaseous phases of water (tertiary point of water)	273,16	0,01
8.		Balance between liquid and vapor phases of water (boiling point of water)	373,15	100
9.		Balance between the solid, liquid and gaseous phases of zinc (solidification point of zinc)	692,73	419,58
10.		Balance between the solid, liquid and gaseous phases of silver (solidification point of silver)	1235,08	961,93
11.		Balance between solid, liquid and gaseous phases of gold (solidification point of gold)	1337,58	1064,43

The International Practical temperature scale used in practical measurements is processed in the form of a thermodynamic scale. This scale is based on the somewhat easily recoverable fixed boiling and melting points of chemically pure substances. Their numerical value was determined by gas thermometers, and the International Practical temperature scale (IPTS-68) was adopted at the XI General Conference on measurements and weights [4,5].

The temperature measured on the international practical scale is represented by the letter t, and the numerical value by the symbol 0S. The relationship between the temperature expressed on the absolute thermodynamic scale and the expression of that temperature on the international scale is determined by the following equation [3]:

$$T=t + 273,15, \qquad (5)$$

where: T is the temperature K on the absolute thermodynamic scale; t is the temperature 0s on the international practical scale

England and the United States apply the Fahrenheit scale (0F), proposed in 1715. This scale is based on two points depending on the state of the water, namely the melting point of the Moss (32 0F) and the boiling point of the water (212 0F) [5].

There is the following relationship between the temperatures calculated on theinternational practical scale, absolute thermodynamic scale and Fahrenheit scale:

t 0C=t 0K - 273,15 = 0,556 (n 0F – 32) (6)

where: n is the number of degrees on the Fahrenheit scale.

Conclusion:

Currently, the International Practical temperature scale (Hahsh-68) is used, adopted in 1968 and forcibly introduced from January 1, 1971 [4]. It consists of the practical application of the absolute thermodynamic temperature scale. This scale is chosen so that the temperature measured on it is close to the thermodynamic temperature, and the subtraction between them is within the limits of modern measurement accuracy. IPTS - 68 will be based on a system of constant, precisely recoverable stagnation temperatures. Their number values will be given. The most important fixed points (temperatures) of hahsh-68 are given in Table 1. Hahsh - 68 rovides temperature measurement in the range from 13.81 ^{0}K to 6300 ^{0}K [6].

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