



LPR Cup

9.s01.e05



Utility must not be confused with indispensability.
– S. Lukyanenko «Stars are cold toys»

Connection

In preparation for a possible meeting with representatives of extraterrestrial civilization and the subsequent exchange of information, a system of units is being developed that will be universal for the entire Universe.

Universal System of Units (USU)

In the new universal system of units, the following fundamental constants are equal to unity (and therefore are dimensionless): the gravitational constant G and the speed of light.

1. (2 pts) Show that in this system of units mass, length and time have the same dimension.
2. (1 pts) Let the centimeter be selected as this unit of measure. Find how many centimeters corresponds to a time equal to 1 second and mass equal to 1 gram.
3. (1 pts) Find how many centimeters corresponds to an energy of 1 electron-volt (energy received by an electron that has passed a potential difference of 1 V) and how many dimensionless units are contained in one horsepower (power developed by a horse weighing 75 kg, which rises vertically at a speed of 1 m/s).

More Universal Unit System (MUSU)

In the new universal system of units, the following fundamental constants are dimensionless and equal, respectively: gravitational constant $G = 6,67 \cdot 10^{-11}$ and the speed of light $c = 3 \cdot 10^8$.

Let the meter be selected as this unit.

1. (1 pts) Find how many meters correspond to a time equal to 1 second; mass equal to 1 kilogram.
2. (1 pts) Find also how many meters correspond to an energy equal to 1 Joule and how many dimensionless units are contained in 1 Watt and 1 Newton.

Extension of the universal system of units to electricity and magnetic field

Suppose that in the USU the electron charge modulus is also the unit (dimensionless).

1. (1 pts) Show how many inverse centimeters (cm^{-1}) in this system are equal to 1 Amp.

2. (1 pts) Find how many centimeters in resistance of 1 Ohm?
3. (2 pts) What are 1 Coulomb, 1 Volt, 1 Farad, 1 Tesla, 1 Weber and 1 Henry equal?

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First hint — 25.05.2020 14:00 (Moscow time)

Second hint — 27.05.2020 14:00 (Moscow time)

Final of the fifth round — 29.05.2020 22:00 (Moscow time)