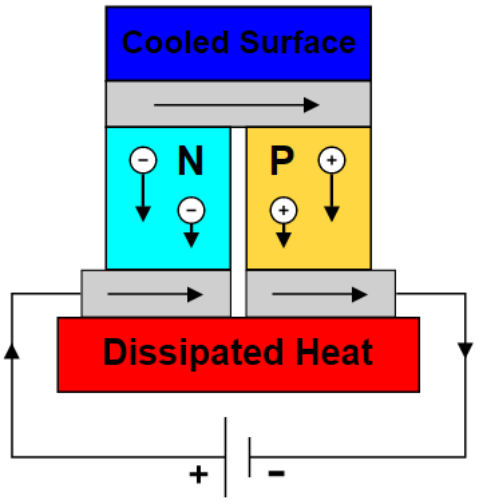
1. The idea is to apply voltage to the free ends of the leads and heat them. Then the connected ends will be cooled (see picture[1]).



To solution 1

2. The Hall voltage is defined by the formula

$$V = \frac{BI}{ned},$$

which implies

$$n = \frac{BI}{eVd} = 7.72 \cdot 10^{28}\ \mathrm{m}^{-3}.$$

3. Usually phosphorus is used in agriculture. As the ^{31}P isotope is stable, then the radioisotope is ^{32}P.

4. Relativistic effects are ignored in the solution. The number of protons which cross a unit area near the Earth's orbit is

$$\frac{dN}{dS} = nv.$$

Each proton can deliver a maximum momentum of $p_0 = 2mv$. Let's consider that in average a proton delivers a momentum $p = mv$. Then the pressure of the solar wind is

$$f = p\frac{dN}{dS} = nmv^2 = 4.2 \cdot 10^{-9}\ \mathrm{Pa}.$$

5. Star formation and dynamics problems are frequently chosen for the IPhO, last ones are 2009.3 and 2012.3. The collapse is stopped by the pressure of the hot electron gas. When the stellar hydrogen is over, then the collapse may continue (in case of a sufficiently big star mass), as the temperature increases.

6. This problem was met in a variety of papers, for example, in "Problems in physics"[2], and in the IPhO as the problem 1987.3. The dispersion relation is

$$\omega(\lambda) = \frac{2}{\sqrt{LC}} \sin\frac{\pi l}{\lambda},$$

the cut-off happens when $\omega = 2/\sqrt{LC}$.

[1] Source here
[2] Link here