

Astronomy and Earth Science Competition

It is recommended to choose the most interesting tasks from the 7 proposed ones (1 or 2 tasks for the 8th grade and below, 2 or 3 tasks for 9th grade and above). You may use the list of questions for each task as a plan for your answer, or you may answer only some of the questions. Contribute reasonable amount of examples and explanations to your answer.

(*) Asterisks denote questions for 9th grade and above, younger students are allowed to ignore them.

1. Many instructors of mountain Tourism and climbing immediately break dark plastic sunglasses if find them as a part of equipment used by beginners. What is the reason for this action?

2. Is that true that the bigger the lake, the bigger stream that flows out of it? Test your explanation on examples of rivers and lakes you know.

3. The visible disk of the Moon has always caused some associations, for example, in ancient China they saw a picture of a “Moon Hare”. Why the Moon is so speckled and what is really there? What other celestial bodies have any visible asymmetry and why?

4*. Pleiades, Hyades, The Beehive Cluster, also known as Praesepe, and other “star pile”. And why do stars group in piles? What was the fate of individual stars and Star clusters? Had ever existed any “relatives” of our Sun? If they had ever existed where they are now?

5*. Is it true that in the newly discovered exoplanets our Sun is a zodiacal star or the star near the ecliptic? How does it look from there? (The exoplanets, or extrasolar planets, are the planets outside the Solar System. By 2013, according o results of observations approximately 1000 exoplanets are known).

6. In February 2014 marks 450 years since the birth of Galileo Galilei (1564–1642) the first human to use a telescope to study the cosmos. What were characteristics and construction of the optical telescopes of Galilei? What discoveries he made using them? What had never been done although his instruments had given him the opportunity?

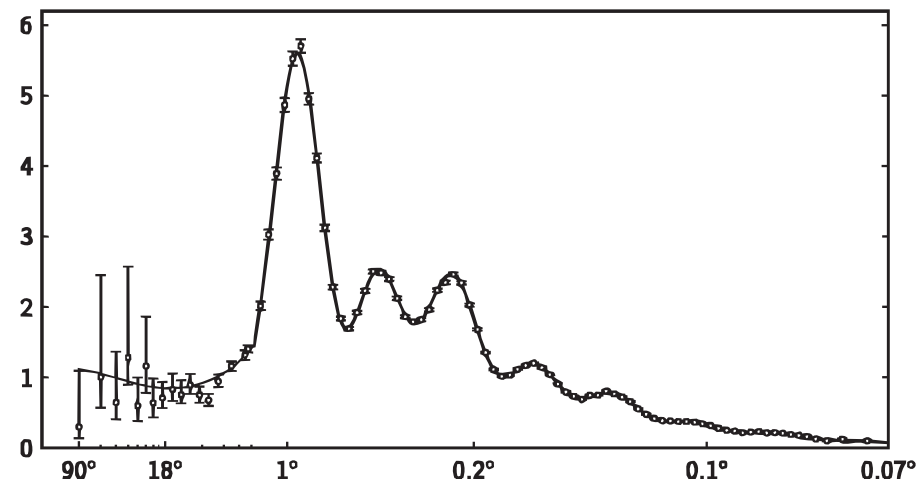
7*. The power and beauty of the scientific knowledge of the world mostly pronounced not when the scientists explain something previously incomprehensible or prove some theory but when on the contrary first some unexpected and extraordinary phenomenon are given by theory and then observed directly as miracles of nature. An example is new and important results of acoustic oscillations in the Universe predicted by Andrei Sakharov in 1965. It turns out that it is possible to determine a number of parameters of our universe, including its age, composition and geometry of space. Why astronomers are now so sure that their perceptions of our universe are true?

Clue to 7

The cosmic microwave background (CMB) uniformly fills space has a black-body spectrum with a temperature $2,72548 \pm 0,00057$ K. At the same time in different areas of the fluctuations of temperature (temperature anisotropy) observed within the specified limits. These inhomogeneities have different angular size on the Celestial sphere.

The graph below the horizontal axis represents the angular dimensions of the irregularities in degrees (for clarity, the axis is patchy scale), and the vertical axis of power CMB in relative units.

Each mark on the graph indicates that the temperature inhomogeneities CMB data with angular scales, we have this portion of the power cosmic microwave background radiation.



Thus, the graph shows the energy distribution (spectrum power) on the CMB on angular scale of temperature inhomogeneities of the radiation on the celestial sphere.

Acoustic oscillations are global processes in the universe leading to the effect described above. Sometimes this name is applied directly to the dependency shown on the graph.