Practical round. Problems to solve

7. Jupiter. In 2009, a nucleus of unknown comet or an asteroid crashed into Jupiter's atmosphere. A powerful explosion formed a dark cloud, which gradually stretched parallel to equator due to zonal flow in the atmosphere. Hubble Space Telescope was able to take a few pictures of Jupiter during this period.

Determine the rate at which the dark cloud on the surface of Jupiter increased its length after the impact with the comet or asteroid by measuring the length of image fragments on the set of the 3 top images displayed on the right.

The photos were taken in the same position of the cloud relative to the central meridian. The scale is determined from the image of Jupiter and position of the fragment marked on it. The equatorial diameter of Jupiter is 143842 km.

8. Comet. In the middle of July 2014, an automatic interplanetary spacecraft Rosetta of European Space Agency made the discovery that the comet 67P / Churyumov–Gerasimenko had a bipartite nucleus. On September 5th Rosetta was able to determine that its albedo was about 0.04 and the maximum nucleus length, 4 km.

On a separate sheet are the pictures demonstrating rotation of the comet nucleus, taken with 40 minutes intervals. Each picture has the date when it was taken and the angle of nucleus rotation relative to the first picture indicated on it. Using these images, determine the rotation period of the comet and plot its light curve based on them. Assume the same albedo over the entire surface of the comet.

According to NASA, the estimated distances at that time were as following:

Rosetta to Sun 557 794 935 km,
Rosetta to Earth 407 252 536 km,
Rosetta to the comet 12 294 km.

Practical round. Problems to solve

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8. **A new variable star.** During late winter – early spring, 2014, a recently discovered variable star GSC 4560-02157, in the constellation of Ursa Minor, was observed at the Tien Shan Observatory of the Kazakhstan Astrophysical Institute, located in the mountains to the south of Almaty city, approximately in 60 km to the north of Cholpon-Ata (Kyrgyzstan). The star features complex physical variability along with regular eclipses. During the night of February 28 – March 1, the star was observed non-stop for almost 9 hours. The table (right) presents the most important data points derived from these observations. The time in the table is the mean solar time for the Almaty time zone.

   At times of the primary minimum, the star's properties correspond to the K0 spectral type.

   Plot the light curve. At the time axis, mark times of minimal brightness in the primary minima and in the secondary minimum. Knowing that the Julian date 2456949.000 begins at today's (October 18) Greenwich noon, label the times of minimal brightness with their Julian dates, with three digits after the decimal point.

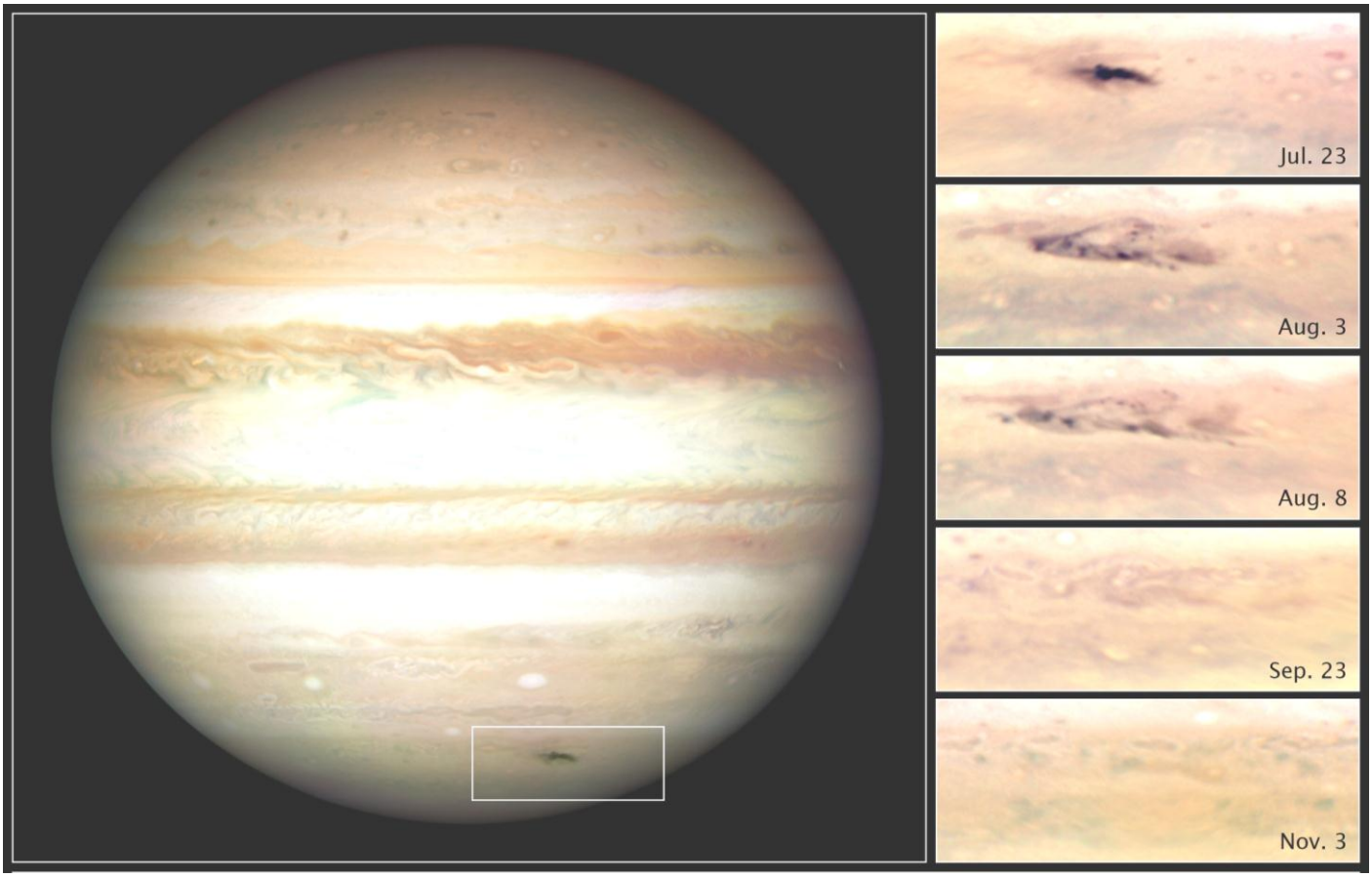
   One of simplified models describing the event assumes that the process involves two stars only. From your analysis of the light curve in the frame of such a model, determine the spectral types (for example, that of the Sun is G2) of the larger (1) and smaller (2) components as well as the ratio of the radii of the larger (R_1) and smaller (R_2) components. Illustrate the solution with necessary figures.

   Almaty and Cholpon-Ata are in the same time zone.

T	m
22 h 00 m (February 28)	14.92
22 h 12 m	15.08
22 h 24 m	15.41
22 h 36 m	15.44
22 h 48 m	15.37
23 h 00 m	15.12
23 h 12 m	14.92
23 h 30 m	14.89
00 h 00 m (March 1)	14.80
00 h 18 m	14.78
00 h 42 m	14.80
01 h 00 m	14.82
01 h 24 m	14.85
01 h 48 m	14.96
02 h 12 m	14.72
02 h 30 m	14.72
03 h 12 m	14.63
03 h 36 m	14.65
04 h 15 m	14.77
04 h 25 m	14.84
04 h 36 m	15.10
05 h 00 m	15.43
05 h 12 m	15.32
05 h 24 m	15.05
05 h 36 m	14.90
05 h 48 m	14.75
06 h 12 m	14.73
06 h 48 m	14.70

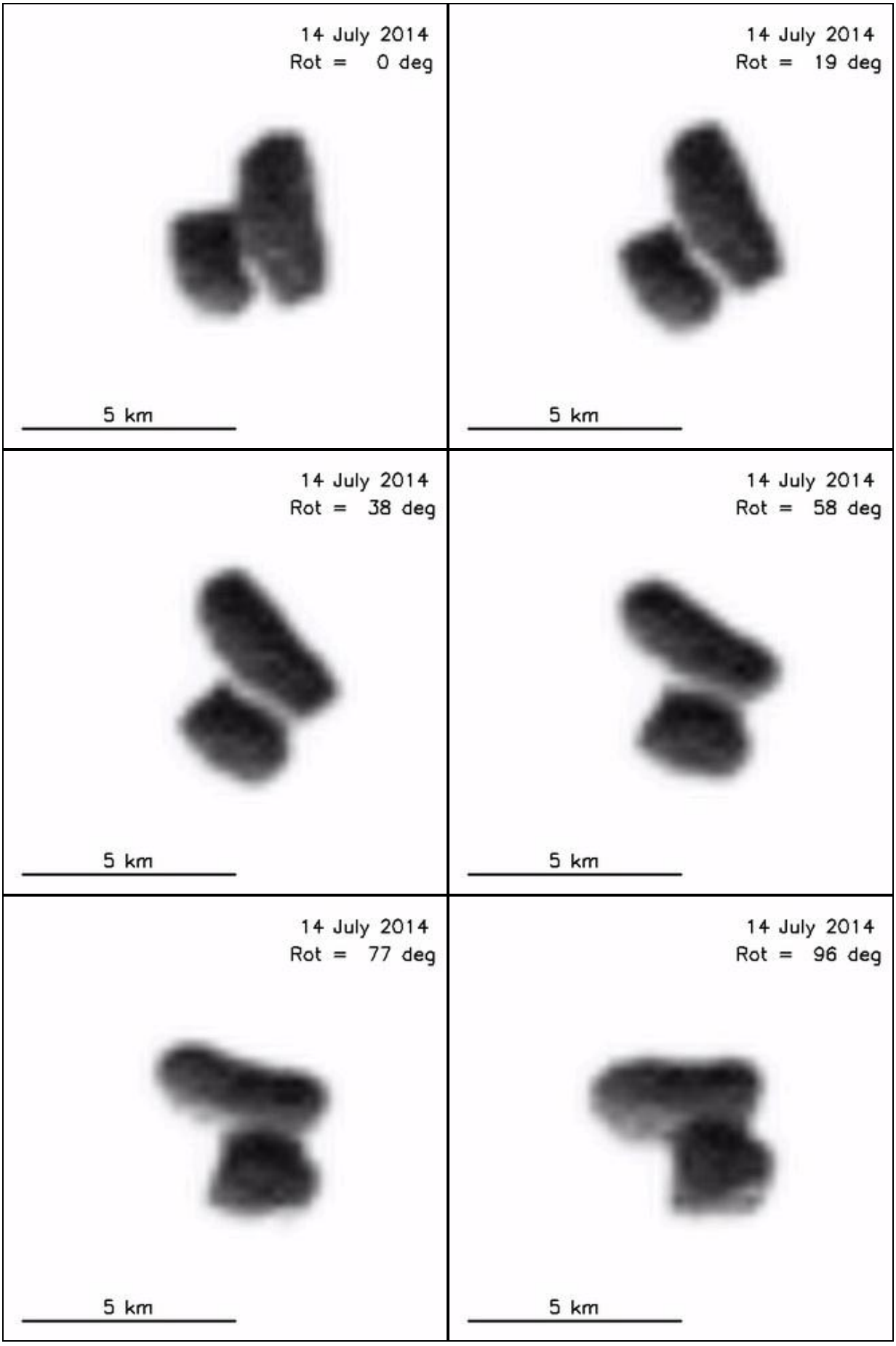
7. Юпитер.

7. Jupiter.



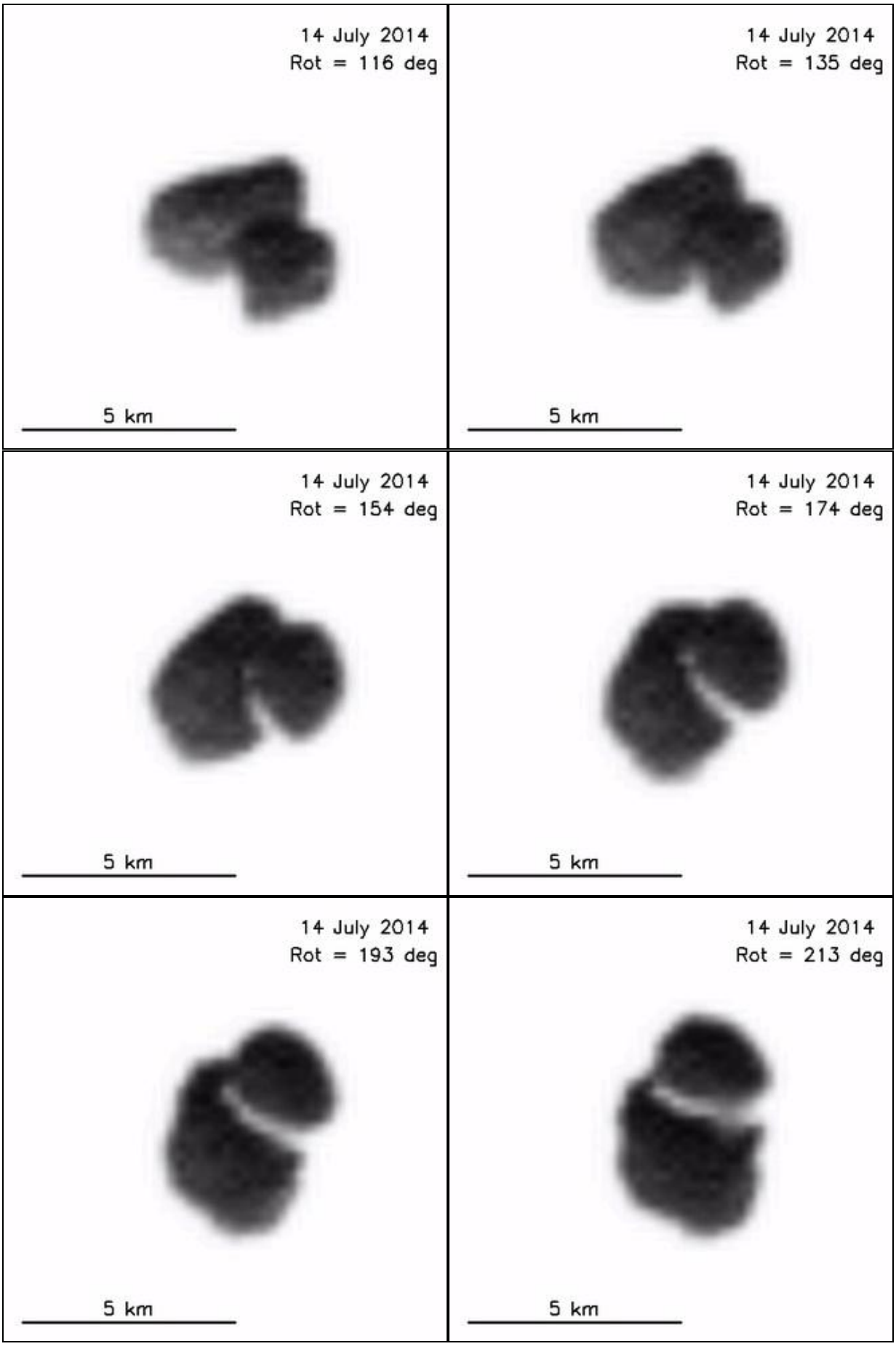
8. Комета. 8. Comet.

1



8. Комета. 8. Comet.

2



8. Комета. 8. Comet. 3

