



LPR Cup

9.s02.e03



*«If I don't rub the stars every evening,»
thought the hedgehog, «they will fade for sure...»
The Hedgehog in the Fog*

Hedgehog in the Nebula

The Hedgehog is located in the Andromeda Nebula in the Juniper Twig System with the Delta Star at the center of it. Several planets move around Delta in circular orbits that lie on one plane.

The Hedgehog itself is on the Beta planet with a period of 540 Earth's days (i.e. 18 months with 30 days each). A day on the Beta planet coincides with the day on Earth. The Hedgehog is carefully watching the Alpha Hatch Planet (which is located farther from the Star) and its Macho Satellite with the orbit lying on the same plane as the planets' orbits.

The Hedgehog observed that the Macho's synodic period relative to Alpha Hatch is equal to 42 hours 28 minutes and 30 seconds (and not a second less!). The Hedgehog recorded the dates when Macho entered the shadow of the Alpha Hatch Planet (see the table).

According to the Hedgehog, Beta Planet's orbital radius is equal to 130 million kilometres.

Note. The sizes and brightness of the Delta Star allow the Hedgehog to see the Alpha Hatch Planet and Macho for the whole year. The size of Macho is negligible.

1. (4 points) Using the data obtained by the Hedgehog, estimate the speed of light in the Juniper Twig System.
2. (3 points) Estimate the orbital radius of the Alpha Hatch planet.
3. (3 points) It is known that Macho is in the Alpha Hatch Planet shadow for 1 hour and 21 minutes, and the maximum angular size of the planet (if you are looking from Beta) is $\Delta\alpha = 1,1 \cdot 10^{-3}$ rad. Find the average density of the Alpha Hatch Planet. The angular size of the Delta star is negligible compared to the size of Alpha Hatch when looking from Macho

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First hint — 18.05.2021 02:00 (GMT+3)

Second hint — 19.05.2021 14:00 (GMT+3)

End of the third tour — 21.05.2021 22:00 (GMT+3)

Data of the Hedgehog

If you need, you can download the data in [csv](#) or [excel](#) format.

Number	Day	Month	Year	Time
0	14	1	75	8:37
1	16	1	75	3:06
2	17	1	75	21:34
3	19	1	75	16:03
4	21	1	75	10:31
5	23	1	75	4:59
6	24	1	75	23:28
7	26	1	75	17:56
8	28	1	75	12:25
9	30	1	75	6:53
10	2	2	75	1:21
11	3	2	75	19:50
12	5	2	75	14:18
13	7	2	75	8:46
14	9	2	75	3:15
15	10	2	75	21:43
16	12	2	75	16:11
17	14	2	75	10:40
18	16	2	75	5:08
19	17	2	75	23:36
20	19	2	75	18:05
21	21	2	75	12:33
22	23	2	75	7:01
23	25	2	75	1:30
24	26	2	75	19:56
25	28	2	75	14:26
26	30	2	75	8:55
27	2	3	75	3:23
28	3	3	75	21:51
29	5	3	75	16:19
30	7	3	75	10:48
31	9	3	75	5:16
32	10	3	75	23:44
33	12	3	75	18:12
34	14	3	75	12:41
35	16	3	75	7:09
36	18	3	75	1:37
37	19	3	75	20:05
38	21	3	75	14:34
39	23	3	75	9:02
40	25	3	75	3:30

Number	Day	Month	Year	Time
41	26	3	75	21:58
42	28	3	75	16:27
43	30	3	75	10:55
44	2	4	75	5:23
45	3	4	75	23:51
46	5	4	75	18:19
47	7	4	75	12:48
48	9	4	75	7:16
49	11	4	75	1:44
50	12	4	75	20:12
51	14	4	75	14:41
52	16	4	75	9:09
53	18	4	75	3:37
54	19	4	75	22:05
55	21	4	75	16:33
56	23	4	75	11:02
57	25	4	75	5:30
58	26	4	75	23:58
59	28	4	75	18:26
60	30	4	75	12:55
61	2	5	75	7:23
62	4	5	75	1:51
63	5	5	75	20:19
64	7	5	75	14:48
65	9	5	75	9:16
66	11	5	75	3:44
67	12	5	75	22:12
68	14	5	75	16:41
69	16	5	75	11:09
70	18	5	75	5:37
71	20	5	75	0:05
72	21	5	75	18:34
73	23	5	75	13:02
74	25	5	75	7:30
75	27	5	75	1:59
76	28	5	75	20:27
77	30	5	75	14:55
78	2	6	75	9:23
79	4	6	75	3:52
80	5	6	75	22:20
81	7	6	75	16:48

Number	Day	Month	Year	Time
82	9	6	75	11:17
83	11	6	75	5:45
84	13	6	75	0:14
85	14	6	75	18:42
86	16	6	75	13:10
87	18	6	75	7:39
88	20	6	75	2:07
89	20	6	75	20:36
90	23	6	75	15:04
91	25	6	75	9:32
92	27	6	75	4:01
93	28	6	75	22:29
94	30	6	75	16:58
95	2	7	75	11:26