



XV Международная астрономическая олимпиада
XV International Astronomy Olympiad

Крым, Судак

16 – 24. X. 2010

Sudak, Crimea

ЯЗЫК
language

English

Practical round. Problem 6 to solve

General note. Translation of your solution of practical round is not proposed. The only formulae, graphs, numerical values, standard defined symbols of objects (like Ω , α UMa, M31, 5^m), etc. but not words and explanations (in any language including English) will be taken into account. Units (kg, pc, nm...) should be written in Latin or Cyrillic.

6. **ZHR.** The visual observations of meteors are necessary to monitor the meteor showers of the high and intermediate activity. Despite the the fact that the accuracy of the visual observations is much lower than that of the photometrical ones, the large number of observations have large significance for the statistical results.

You are provided by supplement papers: the log of the observations and the map of the gnomonic projection with listed meteor events.

1. Observations were organized in Sudak, the local time (LT) used. Please, write in Table 1 the time of the beginning (T_b) and the end (T_e) of observations using Universal time (UT).

2.1. The meteors that belong to the same shower (S) have one radiant. The name of the shower coincides with the name of the constellation where the radiant is situated.

Indicate the place on the map where the radiant is situated (for Perseids). List in Table 2 the numbers of meteors (No) that are showed on the map that belong to this stream (see the supplement).

2.2. Determine and list in Table 2 the equatorial coordinates of the radiant (α, δ).

3. Write in Table 2 the date of the maximum of the meteor shower Perseids (in DD.MM format). Estimate (roughly with an accuracy 1h) the beginning (T_b) and the end (T_e) of the shower visibility during the night of the maximum.

4. The calculation of the hour number of meteors (ZHR) for the Perseid shower.

ZHR is a measure of the shower activity. It can be defined as a number of meteors that are seen by observer during one hour of observations with the favourable conditions and with a radiant situated in zenith. The corresponding formula is:

$$ZHR = \frac{K^{6.5-lm} NF}{T_{eff} \sin h_r}$$

K – coefficient of the luminosity function that is equal to 2.5,

lm – limiting stellar magnitude (each observer determines this value individually taking the most faint star he or she can observe),

N – observed number of meteors,

F – coefficient correcting the cloudiness of the sky,

T_{eff} – effective time of observations in hours,

h_r – the angular altitude of the radiant above the horizon.

4.1. Calculate the mean value of the limiting stellar magnitude (lm) for each interval. Write your results in Table 3.

4.2. Calculate effective time of observations (T_{eff}) for each interval. Write your results in Table 3.

ZHR corresponds to the ideal sky condition. If there is a haze in the sky, some clouds or some extra light (Moon, artificial light, twilights), the visual number of meteors will be decreased, because faint meteors can not be observed.

4.3. Calculate the correction for the cloudiness for each interval (F).

$$F = \frac{1}{1-k}$$

Where k is percentage of the cloudiness, t is corresponding time interval in minutes, and t_{total} is the total time of observation in a given interval.

$$k = \frac{\sum_{i=1}^n k_i t_i}{100 \cdot t_{total}}$$

Write your results in Table 3.

4.4. Calculate zenith hour number (ZHR) of the meteors for Perseids shower for each interval. Write your results in Table 3.

N *T* *S* *m*

21:15 – 22:00

Im = 5.6

| | | | |
|---|-------|-----|-----|
| 1 | 21:18 | Per | 2 |
| 2 | 21:18 | Dra | 3 |
| 3 | 21:20 | Cas | 3.5 |
| 4 | 21:20 | Cyg | 4 |
| 5 | 21:21 | Per | 2 |

k = 20%

| | | | |
|----|-------|-----|-----|
| 6 | 21:22 | Cyg | 3.5 |
| 7 | 21:23 | Cas | 3 |
| 8 | 21:24 | Per | 1 |
| 9 | 21:24 | Her | 4 |
| 10 | 21:24 | Lac | 3.5 |
| 11 | 21:25 | Cas | 3.5 |
| 12 | 21:26 | Cyg | 3 |

k = 0%

| | | | |
|----|-------|-----|-----|
| 13 | 21:26 | Lyr | 4.5 |
| 14 | 21:27 | Lyr | 3 |
| 15 | 21:28 | Cyg | 4 |
| 16 | 21:29 | Boo | 2 |
| 17 | 21:33 | Per | 1.5 |
| 18 | 21:34 | Cyg | 2.5 |
| 19 | 21:35 | Dra | 4 |
| 20 | 21:36 | Per | 1 |
| 21 | 21:37 | Lyr | 3.5 |
| 22 | 21:37 | Peg | 2 |
| 23 | 21:38 | Per | 2.5 |
| 24 | 21:39 | Cyg | 3.5 |
| 25 | 21:40 | Lyr | 4 |
| 26 | 21:41 | Cam | 2 |
| 27 | 21:43 | Cyg | 4 |
| 28 | 21:44 | Cyg | 3.5 |
| 29 | 21:44 | Cyg | 4 |
| 30 | 21:45 | Per | 3 |
| 31 | 21:50 | Per | 1.5 |

Im = 6,0

| | | | |
|----|-------|-----|-----|
| 32 | 21:50 | Oph | 1 |
| 33 | 21:50 | Cep | 4 |
| 34 | 21:51 | Per | 1 |
| 35 | 21:51 | Per | 1.5 |
| 36 | 21:52 | Cam | 2.5 |
| 37 | 21:52 | Peg | 3 |
| 38 | 21:53 | Cas | 3 |
| 39 | 21:53 | Cas | 3.5 |
| 40 | 21:54 | Per | 3 |
| 41 | 21:54 | Dra | 3.5 |
| 42 | 21:55 | Per | 2.5 |
| 43 | 21:59 | Vul | 2 |

22:20 – 23:10

Im = 6.5

| | | | |
|----|-------|-----|-----|
| 44 | 22:23 | Per | 2.5 |
| 45 | 22:25 | Cyg | 3.5 |
| 46 | 22:26 | Per | 2.5 |
| 47 | 22:26 | Dra | 4 |
| 48 | 22:26 | Cyg | 4 |

| | | | |
|----|-------|-----|-----|
| 49 | 22:27 | Per | 1 |
| 50 | 22:27 | Per | 1 |
| 51 | 22:27 | Cas | 2 |
| 52 | 22:29 | Vul | 4 |
| 53 | 22:29 | Lyr | 4 |
| 54 | 22:39 | Per | 2 |
| 55 | 22:30 | And | 4.5 |
| 56 | 22:31 | Per | 2.5 |
| 57 | 22:31 | Cyg | 4 |
| 58 | 22:32 | Per | 2.5 |
| 59 | 22:33 | Peg | 0 |
| 60 | 22:34 | Dra | 4 |
| 61 | 22:34 | Aql | 3.5 |
| 62 | 22:35 | Aql | 2.5 |
| 63 | 22:35 | Aql | 0 |
| 64 | 22:36 | Per | 3 |
| 65 | 22:42 | Cyg | 2 |
| 66 | 22:42 | Per | 2.5 |
| 67 | 22:44 | Cas | 3 |
| 68 | 22:45 | Per | -1 |
| 69 | 22:46 | Cyg | 3.5 |
| 70 | 22:47 | Per | 3 |
| 71 | 22:49 | Cas | 3 |
| 72 | 22:50 | Her | 3 |
| 73 | 22:51 | Per | 3 |
| 74 | 22:51 | And | 5 |
| 75 | 22:53 | Per | 2 |
| 76 | 22:53 | Per | 1.5 |
| 77 | 22:54 | Peg | 1 |
| 78 | 22:56 | Peg | -1 |
| 79 | 23:00 | Per | 2.5 |
| 80 | 23:04 | Per | 3 |
| 81 | 23:04 | Cyg | 4 |
| 82 | 23:05 | Cyg | 4 |
| 83 | 23:05 | Per | 3.5 |
| 84 | 23:06 | Aql | 3 |
| 85 | 23:08 | Per | 0 |
| 86 | 23:09 | Per | 1 |

23:30 – 00:20

Im = 6.5

| | | | |
|-----|-------|-----|-----|
| 87 | 23:31 | Peg | 3 |
| 88 | 23:32 | Per | 2 |
| 89 | 23:32 | Peg | 4 |
| 90 | 23:33 | Aql | 3 |
| 91 | 23:34 | Per | 2.5 |
| 92 | 23:34 | Cyg | 3 |
| 93 | 23:34 | Per | 1 |
| 94 | 23:35 | And | 3 |
| 95 | 23:35 | Cep | 3.5 |
| 96 | 23:36 | Per | 1 |
| 97 | 23:37 | Cyg | 4 |
| 98 | 23:37 | Peg | 3.5 |
| 99 | 23:37 | Per | 0 |
| 100 | 23:38 | Per | 0 |
| 101 | 23:38 | Per | 3 |
| 102 | 23:39 | Lac | 3.5 |

| | | | |
|-----|-------|------|-----|
| 103 | 23:39 | Spor | 0 |
| 104 | 23:40 | Per | -1 |
| 105 | 23:41 | Per | 1 |
| 106 | 23:41 | Per | 2 |
| 107 | 23:42 | Per | 2,5 |
| 108 | 23:42 | Cyg | 3 |
| 109 | 23:43 | Per | 2 |
| 110 | 23:43 | Per | 1 |
| 111 | 23:44 | Per | 1 |
| 112 | 23:45 | Per | 3 |
| 113 | 23:46 | Per | 2,5 |
| 114 | 23:47 | Cas | 2 |
| 115 | 23:47 | Cas | 3,5 |
| 116 | 23:48 | Cyg | 3 |
| 117 | 23:49 | Per | 3,5 |
| 118 | 23:49 | And | 3,5 |
| 119 | 23:49 | Per | 0,5 |
| 120 | 23:50 | Per | 2 |
| 121 | 23:51 | Peg | 3 |
| 122 | 23:51 | Peg | 3 |
| 123 | 23:52 | Cyg | 1,5 |
| 124 | 23:53 | Cep | 1 |
| 125 | 23:53 | Per | 1,5 |
| 126 | 23:53 | Per | 0 |
| 127 | 23:54 | Cep | 1 |
| 128 | 23:54 | Per | 1 |
| 129 | 23:55 | Lac | 3,5 |
| 130 | 23:55 | Lac | 4 |
| 131 | 23:56 | Cas | 0 |
| 132 | 23:58 | Per | 0 |
| 133 | 23:58 | Cas | 2,5 |
| 134 | 23:58 | Per | 0 |
| 135 | 23:58 | Per | 2,5 |
| 136 | 23:59 | Lac | 3 |
| 137 | 23:59 | Cas | 3 |
| 138 | 00:00 | Peg | 2 |
| 139 | 00:00 | Per | 3 |
| 140 | 00:02 | Peg | 3 |
| 141 | 00:02 | And | 5 |
| 142 | 00:04 | Per | 2 |
| 143 | 00:05 | Per | 0 |
| 144 | 00:06 | Cyg | 3,5 |
| 145 | 00:05 | Peg | 0 |
| 146 | 00:06 | Per | 0 |
| 147 | 00:08 | Per | 3 |
| 148 | 00:09 | Per | 0 |
| 149 | 00:10 | Per | 2 |
| 150 | 00:10 | Per | 1 |
| 151 | 00:10 | Peg | 0 |
| 152 | 00:11 | Per | 2 |
| 153 | 00:11 | Peg | 3 |
| 154 | 00:12 | Spor | 1 |
| 155 | 00:12 | Cep | 4 |
| 156 | 00:12 | Per | 1,5 |
| 157 | 00:13 | Aqr | 2 |
| 158 | 00:14 | Per | 0,5 |
| 159 | 00:16 | Per | 0 |

| | | | |
|-----|-------|-----|---|
| 160 | 00:17 | Per | 0 |
| 161 | 00:18 | Cep | 3 |
| 162 | 00:18 | Per | 1 |
| 163 | 00:19 | Per | 2 |

00:40 – 01:30
Im = 6,5

| | | | |
|-----|-------|-----|-----|
| 164 | 00:43 | Per | 1 |
| 165 | 00:44 | Per | 1 |
| 166 | 00:44 | Per | 2 |
| 167 | 00:45 | Per | 3 |
| 168 | 00:45 | Aqr | 2 |
| 169 | 00:47 | Per | 0 |
| 170 | 00:47 | Cyg | 3,5 |
| 171 | 00:50 | Per | 2 |
| 172 | 00:50 | Per | 2 |
| 173 | 00:51 | Per | 1,5 |
| 174 | 00:52 | Peg | 4,5 |
| 175 | 00:52 | Per | 2 |
| 176 | 00:53 | Per | 2 |
| 177 | 00:53 | Per | 2 |
| 178 | 00:54 | Peg | 1,5 |
| 179 | 00:55 | Per | 2 |
| 180 | 00:56 | Per | 0 |
| 181 | 00:56 | Per | 1,5 |
| 182 | 00:56 | Tri | 3,5 |
| 183 | 00:56 | Per | 3 |
| 184 | 00:57 | Peg | 4 |
| 185 | 00:57 | Peg | 2,5 |
| 186 | 00:57 | Per | 1,5 |

k = 10%

| | | | |
|-----|-------|-----|-----|
| 187 | 00:58 | Cas | 5 |
| 188 | 00:59 | Per | 3 |
| 189 | 00:59 | Cyg | 3 |
| 190 | 01:00 | Cyg | 2,5 |
| 191 | 01:00 | Per | 2 |
| 192 | 01:01 | Per | 2,5 |
| 193 | 01:01 | Per | 2 |
| 194 | 01:02 | Cep | 4,5 |
| 195 | 01:04 | Per | 1,5 |
| 196 | 01:06 | Cep | 3,5 |
| 197 | 01:07 | Per | 3 |
| 198 | 01:07 | Aqr | 2 |
| 199 | 01:08 | Umi | 3 |
| 200 | 01:08 | Peg | 3 |
| 201 | 01:08 | Per | 2 |
| 202 | 01:09 | Peg | 1,5 |
| 203 | 01:09 | Cyg | 1 |
| 204 | 01:09 | Cas | 2 |
| 205 | 01:09 | Per | 1,5 |
| 206 | 01:09 | Peg | 4 |
| 207 | 01:10 | Per | 2 |
| 208 | 01:11 | Per | 2 |
| 209 | 01:11 | Per | 0 |
| 210 | 01:11 | Per | 0 |
| 211 | 01:12 | Per | 2 |
| 212 | 01:13 | Per | 1,5 |

k = 0%

| | | | |
|-----|-------|-----|-----|
| 213 | 01:13 | Per | 2 |
| 214 | 01:14 | Per | 3 |
| 215 | 01:14 | Per | 4,5 |
| 216 | 01:15 | Per | 4 |
| 217 | 01:16 | Peg | 3 |
| 218 | 01:16 | Cas | 4 |
| 219 | 01:17 | Per | 3 |
| 220 | 01:18 | Per | 3 |
| 221 | 01:18 | Aqr | 3 |
| 222 | 01:18 | Per | 2 |
| 223 | 01:19 | Per | 0 |
| 224 | 01:21 | Per | 0 |
| 225 | 01:22 | Per | 1 |
| 226 | 01:22 | Cas | 4 |
| 227 | 01:22 | Cas | 2,5 |
| 228 | 01:23 | Per | 3 |
| 229 | 01:23 | Per | 2 |
| 230 | 01:24 | Per | 0 |
| 231 | 01:24 | Per | 1,5 |
| 232 | 01:25 | Per | 0 |
| 233 | 01:25 | Peg | 5 |
| 234 | 01:26 | And | 3 |
| 235 | 01:27 | Cep | 3 |
| 236 | 01:28 | Per | 0,5 |
| 237 | 01:29 | Per | 2 |
| 238 | 01:30 | Per | 1 |

01:50 - 02:40

Im = 6,5

| | | | |
|-----|-------|-----|-----|
| 241 | 01:51 | Per | 1,5 |
| 242 | 01:53 | Per | 2 |
| 243 | 01:53 | Per | 2,5 |
| 244 | 01:55 | Peg | -2 |
| 245 | 01:56 | Peg | -1 |
| 246 | 01:57 | Per | 0 |
| 247 | 01:57 | And | 4 |
| 248 | 01:58 | Tri | 2 |
| 249 | 01:58 | Cyg | 3,5 |
| 250 | 01:59 | Per | 1 |
| 251 | 02:00 | Per | 2 |
| 252 | 02:03 | Tau | 3 |
| 253 | 02:03 | Per | 2,5 |
| 254 | 02:03 | Per | 1,5 |
| 255 | 02:04 | Per | 1 |
| 256 | 02:06 | Per | 2,5 |
| 257 | 02:06 | Ari | 3,5 |
| 258 | 02:06 | Lac | 4 |
| 259 | 02:07 | Per | 1,5 |
| 260 | 02:08 | Per | 1 |
| 261 | 02:08 | Per | 1 |
| 262 | 02:08 | Per | 2 |
| 263 | 02:08 | Per | 0,5 |
| 264 | 02:08 | Peg | 2 |
| 265 | 02:11 | Per | 3 |
| 266 | 02:11 | Cas | 3 |
| 267 | 02:11 | Per | 0 |

| | | | |
|-----|-------|-----|-----|
| 268 | 02:12 | Aql | 2 |
| 269 | 02:12 | Per | 0 |
| 270 | 02:13 | Dra | 3 |
| 271 | 02:13 | Per | 3 |
| 272 | 02:13 | And | 5 |
| 273 | 02:14 | Per | 2 |
| 274 | 02:14 | Per | 2,5 |
| 275 | 02:14 | Cas | 4,5 |
| 276 | 02:15 | Per | 2,5 |
| 277 | 02:15 | Per | 3 |
| 278 | 02:15 | Per | 1 |
| 279 | 02:15 | Per | 0,5 |
| 280 | 02:15 | Per | 3 |
| 281 | 02:16 | Per | 2 |
| 282 | 02:17 | Cas | 3 |
| 283 | 02:18 | Per | -3 |
| 284 | 02:19 | Per | 2 |
| 285 | 02:20 | Per | 3 |
| 286 | 02:20 | Per | 3 |
| 287 | 02:21 | Cas | 5 |
| 288 | 02:21 | Per | 0 |
| 289 | 02:21 | Per | 1 |
| 290 | 02:22 | Peg | 4 |
| 291 | 02:23 | Peg | 3 |
| 292 | 02:24 | Per | 4 |
| 293 | 02:25 | Per | 1 |
| 294 | 02:25 | Per | 1 |
| 295 | 02:25 | Per | -1 |
| 296 | 02:26 | Per | 1 |
| 297 | 02:26 | Per | 4 |
| 298 | 02:27 | Per | 2,5 |
| 299 | 02:27 | Per | 2 |
| 300 | 02:28 | Per | 1 |
| 301 | 02:28 | Per | 3 |
| 302 | 02:28 | Per | 3 |
| 303 | 02:28 | Per | 2 |
| 304 | 02:29 | Peg | 2 |
| 305 | 02:30 | Per | 1 |
| 306 | 02:30 | Per | 1 |
| 307 | 02:30 | Per | 1 |
| 308 | 02:30 | Per | 4 |
| 309 | 02:30 | Per | 2 |
| 310 | 02:31 | Per | 2 |
| 311 | 02:31 | Per | 1 |
| 312 | 02:31 | Per | 1,5 |
| 313 | 02:32 | Per | -1 |
| 314 | 02:33 | Per | 1 |
| 315 | 02:33 | Tau | 3 |
| 316 | 02:33 | Per | 2,5 |
| 317 | 02:35 | Cyg | 2 |
| 318 | 02:36 | Per | 2 |
| 319 | 02:37 | Per | 1 |
| 320 | 02:38 | Per | 1 |
| 321 | 02:38 | Per | 1 |
| 322 | 02:38 | Per | 1,5 |
| 323 | 02:38 | Peg | 2 |
| 324 | 02:39 | Per | 1 |

| | | | |
|-----|-------|-----|---|
| 325 | 02:39 | Per | 2 |
| 326 | 02:39 | Per | 1 |
| 327 | 02:40 | Per | 2 |

03:00 – 04:00

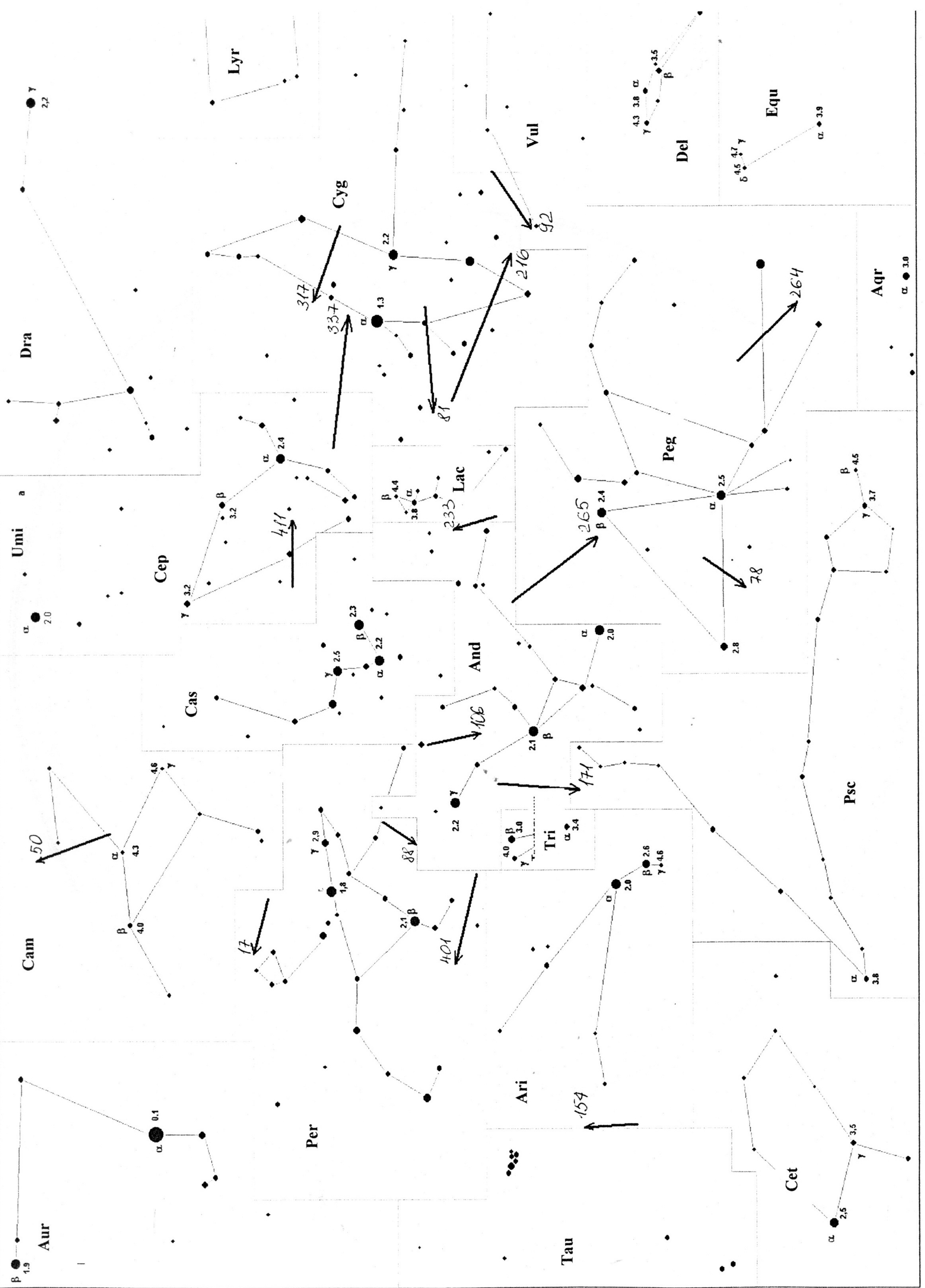
Im = 6,5

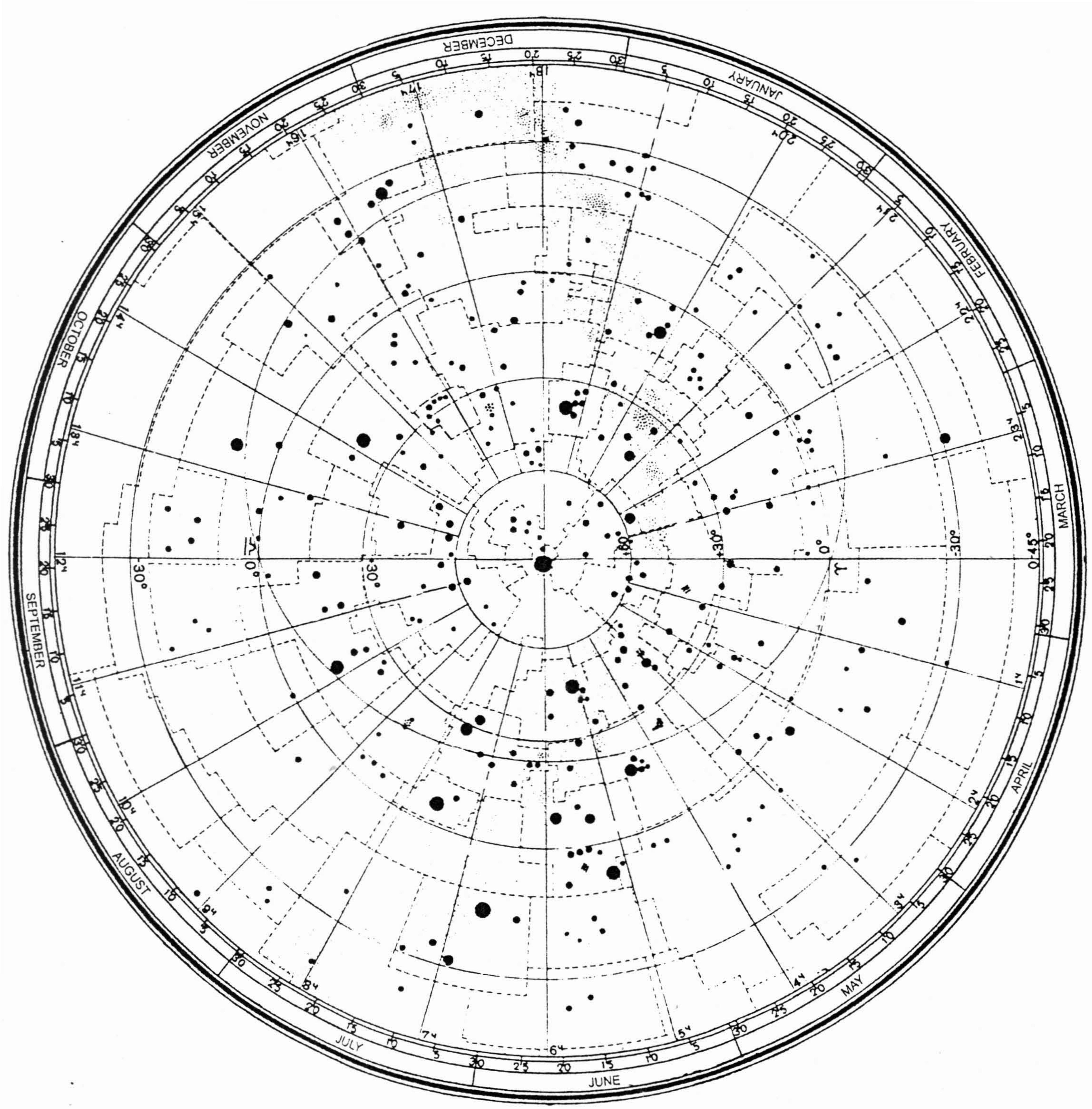
| | | | |
|-----|-------|------|-----|
| 328 | 03:03 | Cas | 2 |
| 329 | 03:03 | Per | 3 |
| 330 | 03:04 | Per | 2 |
| 331 | 03:04 | Cyg | 3 |
| 332 | 03:04 | Psc | 3 |
| 333 | 03:05 | Peg | 3 |
| 334 | 03:05 | And | 4.5 |
| 335 | 03:06 | Lac | 2,5 |
| 336 | 03:07 | Per | 2 |
| 337 | 03:07 | Per | 1,5 |
| 338 | 03:07 | Per | 2 |
| 339 | 03:08 | And | 1 |
| 340 | 03:08 | Per | 3 |
| 341 | 03:08 | Per | 3 |
| 342 | 03:08 | Per | 3 |
| 343 | 03:09 | Per | 2 |
| 344 | 03:09 | Dra | 2 |
| 345 | 03:10 | Per | 2 |
| 346 | 03:11 | Per | 2 |
| 347 | 03:11 | Per | 2 |
| 348 | 03:11 | Per | 0 |
| 349 | 03:12 | Per | -1 |
| 350 | 03:13 | Spor | 0 |
| 351 | 03:14 | Per | 3 |
| 352 | 03:15 | Per | 0 |
| 353 | 03:15 | Per | 2 |
| 354 | 03:16 | Per | 2 |
| 355 | 03:16 | Per | 1 |
| 356 | 03:16 | Per | 0 |
| 357 | 03:17 | Peg | 3,5 |
| 358 | 03:17 | Peg | 3 |
| 359 | 03:18 | Per | 2 |
| 360 | 03:19 | And | 3 |
| 361 | 03:20 | Peg | 4 |
| 362 | 03:21 | Cet | 2 |
| 363 | 03:22 | Per | 2,5 |
| 364 | 03:22 | Per | 3 |
| 365 | 03:22 | Per | 3 |
| 366 | 03:22 | Tri | 4 |
| 367 | 03:23 | Per | 0,5 |
| 368 | 03:23 | Per | 0 |
| 369 | 03:24 | Aqr | 2 |
| 370 | 03:25 | Per | -3 |

Im = 6,0

| | | | |
|-----|-------|-----|-----|
| 371 | 03:28 | Cas | 2,5 |
| 372 | 03:28 | Per | 3 |
| 373 | 03:28 | Per | 3 |
| 374 | 03:29 | Per | 1,5 |
| 375 | 03:29 | Peg | 3 |
| 376 | 03:29 | Lac | 3 |
| 377 | 03:30 | Per | 2 |

| | | | |
|-----|-------|------|------|
| 378 | 03:31 | Cas | 2 |
| 379 | 03:32 | Per | 3 |
| 380 | 03:33 | Per | 3 |
| 381 | 03:33 | Cas | 3 |
| 382 | 03:33 | Peg | 2 |
| 383 | 03:34 | Spor | 1 |
| 384 | 03:35 | Per | 2,5 |
| 385 | 03:35 | Cas | 3,5 |
| 386 | 03:35 | Cas | 3 |
| 387 | 03:36 | Per | 2,5 |
| 388 | 03:36 | Per | 3 |
| 389 | 03:37 | Per | 0,5 |
| 390 | 03:38 | Boo | 3 |
| 391 | 03:39 | Psc | 4 |
| 392 | 03:38 | Per | 3 |
| 393 | 03:38 | Per | 3 |
| 394 | 03:40 | Per | 3 |
| 395 | 03:40 | Per | 2,5 |
| 396 | 03:40 | Per | 3 |
| 397 | 03:41 | Per | 2 |
| 398 | 03:42 | Per | 2 |
| 399 | 03:42 | Per | 2 |
| 400 | 03:42 | Per | 0 |
| 401 | 03:42 | And | 4 |
| 402 | 03:43 | Per | 1,5 |
| 403 | 03:44 | Per | 1 |
| 404 | 03:45 | Per | 3 |
| 405 | 03:45 | Per | 3,5 |
| 406 | 03:46 | Per | 3 |
| 407 | 03:48 | Psc | 3 |
| 408 | 03:48 | Per | 2,5 |
| 409 | 03:48 | Cyg | 3 |
| 410 | 03:49 | Per | 2 |
| 411 | 03:49 | Per | 1 |
| 412 | 03:50 | Per | 3 |
| 413 | 03:51 | Per | 1,5 |
| 414 | 03:51 | Per | 3 |
| 415 | 03:51 | Per | 3 |
| 416 | 03:51 | Boo | 4,5 |
| 417 | 03:52 | Per | 2 |
| 418 | 03:53 | Per | 3 |
| 419 | 03:53 | Per | 3 |
| 420 | 03:54 | Aqr | 3 |
| 421 | 03:54 | Cas | 2,5 |
| 422 | 03:55 | Per | 2 |
| 423 | 03:55 | Peg | 1,5 |
| 424 | 03:55 | Per | 3 |
| 425 | 03:56 | Per | 3 |
| 426 | 03:59 | Per | 1 |
| 427 | 03:59 | Per | -0,5 |







XV Международная астрономическая олимпиада
XV International Astronomy Olympiad

Крым, Судак

16 - 24. X. 2010

Sudak, Crimea

| | |
|----------|-----------------------|
| язык | <i>Русский</i> |
| language | |
| язык | <i>English</i> |
| language | |

Practical. Tables for problem 6 to solve

Таблицы к задаче 6 практического тура

Table 1.
Таблица 1.

| | (LT) | (UT) |
|-------|------|------|
| T_b | | |
| T_e | | |

Table 2.
Таблица 2.

| | |
|------------|------------|
| No | |
| $\alpha =$ | $\delta =$ |
| DD.MM | |
| T_b | |
| T_e | |

Table 3.
Таблица 3.

| No | h_r | lm | N | T_{eff} | F | ZHR |
|----|-------|----|---|-----------|---|-----|
| | 23 | | | | | |
| | 29 | | | | | |
| | 37 | | | | | |
| | 47 | | | | | |
| | 54 | | | | | |
| | 63 | | | | | |



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| | |
|----------|----------------|
| язык | <i>English</i> |
| language | |

Practical round. Problem 7 to solve

7. **Cataclysmic variable.** Photometric data of the cataclysmic variable HS 2332+3905 of WZ-Sge type are given. Magnitude of the variable was changing with the orbital period during the observations.

Objects of this type consist of white dwarf with a late-type secondary.

Table 1 consist of:

- 1st column – Julian date (JD),
- 2nd column – relative magnitude of the variable (Mg),
- 3rd column – phase of the orbital period (Phasa).

7.1. What is the year of the observations? (January 1st, 2000 corresponds to JD = 2451545)

7.2. With the data of the table 1, plot a graph brightness vs. time (“x” axis – time; “y” axis – the magnitude of the system that equals to sum of relative magnitude of the system and magnitude of the comparison star 4.6^m). Brightness should increase upward on the vertical axis.

7.3. From the graph you should find the times corresponding to the maximum and minimum brightness of the system and also corresponding magnitudes of the system at these times. Write these data in the table 2.

Table 2 consist of:

- 1st column – JD corresponding to maximum brightness (JD_{max})
- 2nd column – magnitude in maximum brightness (Mg_{max})
- 3rd column – JD corresponding to minimum brightness (JD_{min})
- 4th column – magnitude in minimum brightness (Mg_{min})

7.4. Find the orbital period (P_{orb}) of the system using the graphical plot.

7.5. Using the ephemeris $JD = JD_0 + P_{orb} * E$, find the phases of orbital period corresponding to the magnitudes that you have found. Write these data in the table 1, plot a phase diagram (“x” axis – phases from 0 to 1; “y” axis – magnitudes).

JD – Julian date (1st column in the table);

JD₀ – Julian date corresponds to the minimum of brightness, the phase is “0”;

P – orbital period, that you have found by the graph;

E – number, that consists of integer part N and fractional part Phase;

N – number of the cycle,

Phasa – phase, values from 0 to 1. (e. g.: 0.1, 0.2, and etc., 1 – the complete period).

One of the features of such types of systems is sudden increase in brightness of 6-8 magnitudes (called superoutburst) after which during the attenuation of the superoutburst one can observe superhumps (variations of brightness with a frequency close to orbital period).

7.6. On investigation of the system superoutburst and superhumps were observed. It was found that the period of these superhumps is 2.3 minutes larger than the orbital period. Using the figure 1, the orbital period (that you have found) and the period of superhumps, find the ratio of masses of the components.

XV Международная астрономическая олимпиада
XV International Astronomy Olympiad

Крым, Судак

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Sudak, Crimea

| | |
|----------|----------------|
| язык | <u>Русский</u> |
| language | |
| язык | <u>English</u> |
| language | |



Practical. Tables for problem 7 to solve

Таблицы к задаче 7 практического тура

Table 1.

| JD 2400000 + ... | Mg | Phasa |
|---------------------|------|-------|
| 53256,337 | | 0 |
| 53256,342 | 1,2 | |
| 53256,344 | 1,1 | |
| 53256,36 | 0,98 | |
| 53256,374 | 0,94 | |
| 53256,38 | 0,85 | |
| 53256,384 | 0,92 | |
| 53256,385 | 1 | |
| 53256,392 | 1,15 | |
| 53256,393 | 1,23 | |
| 53256,407 | 1,05 | |

| JD 2400000 + ... | Mg | Phasa |
|---------------------|------|-------|
| 53256,426 | 0,96 | |
| 53256,432 | 0,94 | |
| 53256,436 | 0,85 | |
| 53256,44 | 0,92 | |
| 53256,441 | 1 | |
| 53256,443 | 1,19 | |
| 53256,449 | 1,23 | |
| 53256,454 | 1,2 | |
| 53256,459 | 1,08 | |
| 53256,464 | 1 | |

Table 2.

| JD _{max} | Mg _{max} | JD _{min} | Mg _{min} |
|-------------------|-------------------|-------------------|-------------------|
| | | | |
| | | | |
| | | | |
| | | | |

Figure 1.

