V Азиатско-Тихоокеанская астрономическая олимпиада

V Asian-Pacific Astronomy Olympiad

Practical round

β-7. Quasar. The figure 1 of the attachments is the spectrum of a quasar SNUQSO J193013.80+341049.5 (see separate sheet, flux vs wavelength in Å) discovered by the Seoul National University Bright Quasar Survey in Optical (SNUQSO) using the Bohyunsan Optical Astronomy Observatory's 1.8 m telescope. Do the following:

7.1. Table (right) provides the central wavelength of prominent emission lines under laboratory conditions. These lines are typically found in quasars. Use the data in the table to identify the following emission lines and determine the redshift of this quasar.

Atomic Species	Central wavelength in Å	Transition
H alpha	6563	E-1
O III	5007	M-1
O III	4959	M-1
H beta	4861	E-1
H gamma	4340	E-1

7.2. Measure the values of the Full Width at Half Maximum (FWHM) for H beta and [O III] 5007 and calculate the corresponding values in units of km/s. Note that the instrumental resolution of the spectrograph is 1500 km/s in FWHM. The FWHM values represent the circular orbit motions of the clouds surrounding the central supermassive black hole in the quasar.

7.3. Figure (see separate sheet) depicts a schematic model of a quasar, where the centre circle represents the supermassive black hole accreting matter in the form of a thin disk. If the centre black hole has a mass of 10^8 of solar mass, indicate on the figure provided where the emission regions are for H beta and [O III] 5007.

β-8. Open cluster. Below is the photometric data of an open cluster obtained using a Mt. Bohyun Optical Telescope.

ID	m_V	(B-V)									
-1	8.710	-0.061	-9	8.044	-0.072	-18	8.042	-0.120	84	10.308	0.151
-3	7.712	-0.150	-11	6.874	-0.063	34	9.757	0.065	119	10.535	0.222
-4	7.394	-0.093	-12	7.862	-0.110	44	10.244	0.149	128	9.610	0.017
-5	6.516	-0.117	-13	7.653	-0.135	57	10.931	0.300	136	10.198	0.161
-6	8.030	-0.145	-14	7.490	-0.076	59	11.633	0.417	137	10.863	0.290
-7	8.202	-0.059	-15	5.447	-0.198	72	11.334	0.400	142	11.281	0.336
-8	7.276	-0.182	-16	8.036	-0.084	73	9.763	0.061	407	10.527	0.199
			-17	4.816	1.642	75	11.631	0.426	419	9.891	0.069

8.1. Draw a Color-Magnitude diagram using V-magnitude (m_V) vs B-V color index for this stellar cluster using data of this table, which were corrected for interstellar extinction.

8.2. Hence use the ZAMS (Zero Age Main Sequence) relation to deduce the distance to this cluster. Table of the ZAMS relation (absolute magnitude M_v vs B-V colour index) is below.

M_v	B-V						
-5.00	-0.330	-2.50	-0.277	0.50	-0.138	3.00	0.270
-4.50	-0.324	-2.00	-0.260	1.00	-0.100	3.50	0.370
-4.00	-0.315	-1.50	-0.240	1.50	-0.045	3.75	0.415
-3.50	-0.305	-1.00	-0.220	2.00	0.040	4.00	0.460
-3.00	-0.290	-0.50	-0.200	2.25	0.100		
		0.00	-0.175	2.50	0.165		

Figure 1 for Problem 7. **Рисунок 1 к задаче 7.**

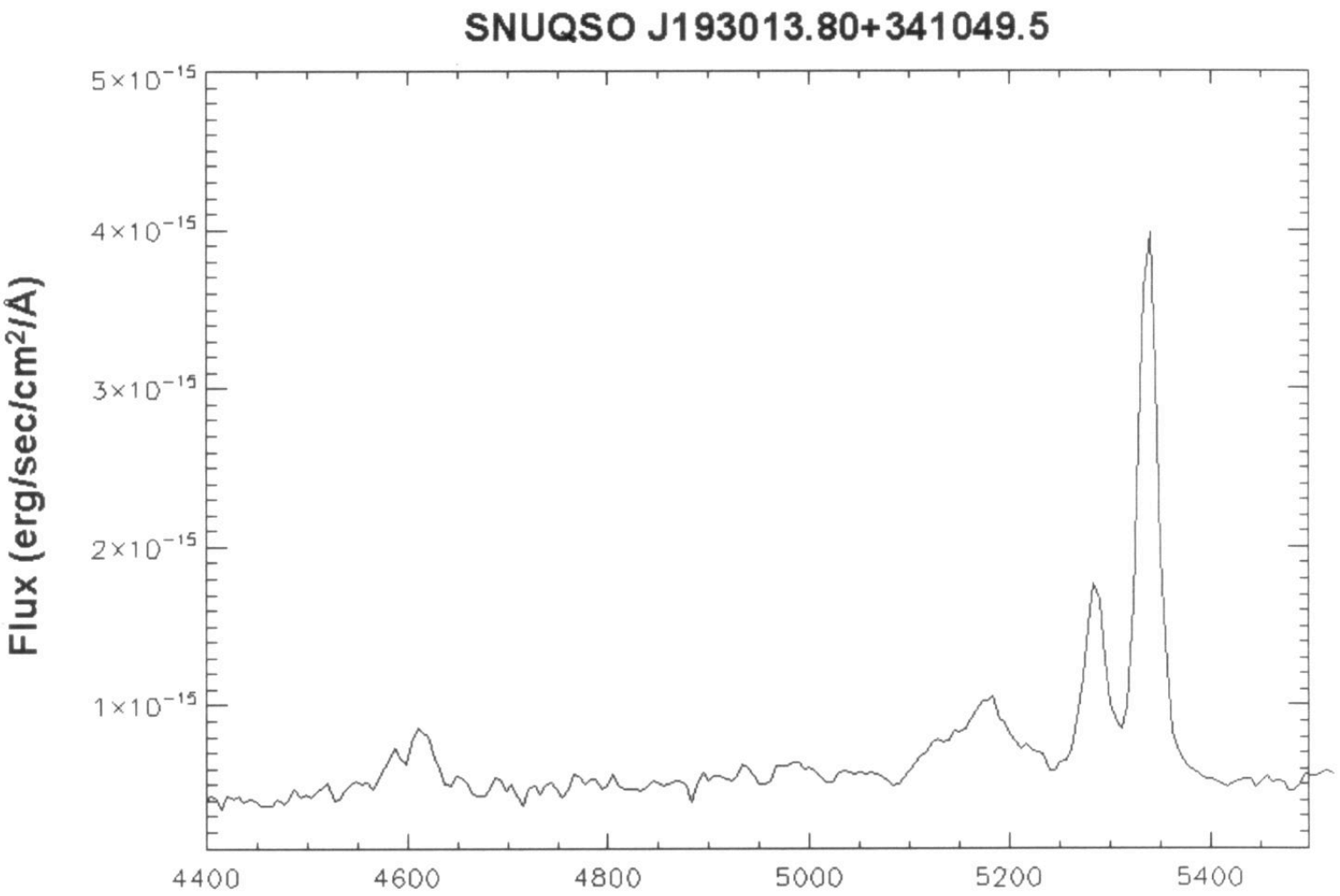


Figure 2 for Problem 7.

Рисунок 2 к задаче 7.

