
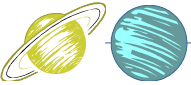










Physics 344

Lab 1 Solutions

The purpose of this lab was to become familiar with the planetarium program *The Sky*, which can show the appearance of the night sky from anywhere on Earth over a broad range of times. In this class we will use it to control the pointing of the 0.5 m telescope of the Schommer Observatory. Answers to the questions posed by the lab follow.

Q1. An earlier version of the *The Sky* had different symbols for the three kinds of galaxies. However, I was unable to make the current version do this. The default in the current version of *The Sky* is to show a thumbnail picture of the galaxy, if it is available. Otherwise a galaxy is represented with an elliptical blob like the symbol shown below for elliptical galaxies.

Object	Symbol	Description
Star		A hot, dense, sphere of gas, producing energy by fusion reactions in its core.
Planet		Small spherical gaseous or rocky objects orbiting about stars, which do not produce significant amounts of energy.
Comet		Very small bodies, mostly ices, with some rocky material mixed in, orbiting about stars. Near their stars they sublimate and form comas and tails.
Open Cluster		A self-gravitating group of hundreds to thousands of stars. Rather asymmetrical, usually young, found in the disk of the Galaxy.
Globular Cluster		A self-gravitating group of hundreds of thousands to millions of stars. Spherical shape, very old, found in the halo of the Galaxy.
Nebula		A cloud of gas that glows from ionization by embedded hot stars. Often sites for star formation.
Planetary Nebula		A spherical shell of gas ejected from a medium mass star at the end of its life. Ionized by the hot remnant core of the star.
Spiral Galaxy		A disk-shaped structure containing typically 10^{11} stars, and also gas and dust in its interstellar medium.
Elliptical Galaxy		A spheroidal-shaped structure containing typically 10^{12} stars, and little or no interstellar medium.
Irregular Galaxy		A galaxy with no regular shape, usually significantly smaller than an elliptical or spiral galaxy. Usually has active star formation and lots of interstellar medium.

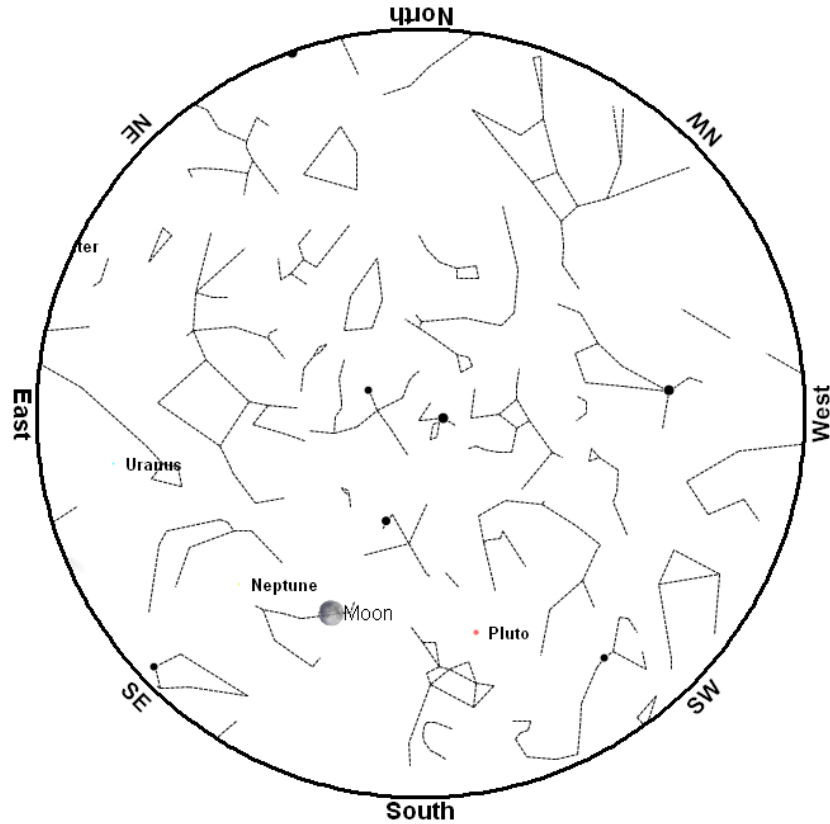
Q2. Uranus has just risen above the eastern horizon and is in the constellation Pisces. Neptune is in Aquarius, in the southeast. Saturn is in Virgo, very low in the west. Pluto (no longer officially a planet) is in Sagittarius, just east of the meridian. The Moon (also not a planet) is in Capricornus in the southeast. For astronomers, constellations are regions of the sky rather than patterns of stars. They have divided the entire sky into constellations based on either the classically named patterns or (mostly in the southern celestial hemisphere) more modern creations. When a planet appeared to be between the two patterns of stars belonging to two constellations, it was useful to turn on the actual constellation boundaries.

Q3. The Object Information for Sadr

Field	Value	Meaning
Object Name	Sadr	The common name of the object
Other ID	HIP 100453	Alternate name: Hipparchos Catalog designation
Magnitude	2.23	Apparent Brightness – visible in NJ skies!
Equatorial RA	20 ^h 22 ^m 40.936 ^s	Equatorial E-W coordinate at the present time
Equatorial Dec	+40° 17' 59.313"	Equatorial N-S coordinate at the present time
Eq 2000 RA	20 ^h 22 ^m 13.702 ^s	Equatorial E-W coordinate on Jan 1, 2000
Eq 2000 Dec	+40° 15' 24.045"	Equatorial N-S coordinate on Jan 1, 2000
Horizon Azim	79° 49' 59.095"	Coordinate along horizon
Horizon Alt	65° 27' 33.983"	Coordinate of elevation above horizon
Alternate Names	HIP 100453 SAO 49528 GSC 3156:2223	Hipparchos Catalog (proper motion satellite) Smithsonian Astrophysical Observatory Catalog Hubble Space Telescope Guide Star Catalog
Visibility Rise	12:59	Local Time object crosses our eastern horizon
Visibility Set	07:23	Local Time object crosses our western horizon
Transit Time	22:09	Crosses meridian at 9:59 pm tonight
Flamsteed-Bayer	37-Gamma Cygni	Constellation name and brightness rank
Name 6	PPM 59799	Positions and Proper Motion Catalog
Name 7	HD 194093	Henry Draper Catalog
Name 8	B+39 4159	Bonner Durchmusterung Catalog
Object Type	Star	Known world-wide and fabulously wealthy
Spectral	F8Ib	Spectral Type – late F supergiant
Source Catalog	Hipparcos Cat.	Source of specialized information (none for Sadr)
Sun Distance	963865590	Distance from Sun (in AU)
Hour Angle	-02 ^h 09 ^m 13.480 ^s	Local sidereal time – object's right ascension
Air Mass	1.10	Secant of angle between zenith and object
Magnitude B	3.08	Apparent brightness in blue filter
Magnitude V	2.31	Apparent brightness in visual (green) filter
Screen x,y	547.00, 402.00	Location on computer display (pixels)
Parallax	2.1400	Annual apparent position shift (milliarcsec)
Proper Motion	2.43, -0.93	RA, Dec motion across the sky (milliarcseconds/yr)
Position Error	0.3900, 0.4000	RA, Dec uncertainty (milliarcsec)
Sidereal Time	18:18	LST at the specified time
Click Distance	1.0	Cursor distance from object when clicked (pixels)
Light Years	1524.10	Distance to object in light years
Parsecs	467.2897	Distance to object in parsecs

Catalog Number	49528	Smithsonian Astrophysical Observatory Catalog
Julian Date	2455813.500	For the selected date/time
Angular Separation	---	From previous object
Position angle	---	From previous object

Q4. Your sketch should look something like the figure below. I produced it in *The Sky* after a remarkable amount of messing around with settings. The bright stars visible are listed in the table below.



Star	Magnitude	RA	Dec	Sp Type
Arcturus	-0.05	14 ^h 16 ^m 09.9 ^s	+19° 08' 04.1"	K2IIIp
Antares	1.06	16 ^h 30 ^m 04.9 ^s	-26° 27' 23.1"	M1Ib
Vega	0.03	18 ^h 37 ^m 19.2 ^s	+38° 47' 52.0"	A0V
Altair	0.76	19 ^h 51 ^m 19.7 ^s	+8° 53' 57.2"	A7IV-V
Deneb	1.25	20 ^h 41 ^m 49.8 ^s	+45° 19' 24.5"	A2Ia
Fomalhaut	1.17	22 ^h 58 ^m 16.7 ^s	-29° 33' 41.0"	A3V
Capella	0.08	05 ^h 17 ^m 30.2 ^s	+46° 00' 27.9"	G0

The three stars Vega, Altair, and Deneb form the “Summer Triangle”, an asterism that is striking in the summer and fall sky. Antares and Fomalhaut are low on the southern horizon and may be difficult to see unless you have an unobstructed view to the South. Capella is just rising in the NNE and will be difficult to spot until later in the evening.

The stars of the summer triangle will be blue-white in color, in contrast to the red color of Arcturus (and Antares if it is visible). Capella is an intermediate yellow shade.

Q5. As time passes, the sky appears to rotate from east to west, about a point above the Earth's north pole (i.e. the north celestial pole). At 6:00 am, Mercury is low in the east, Mars and Jupiter are high in the east and west, respectively, and Uranus is low in the western sky.

Q6. Be careful about "midnight"! The Sky displays local civil time, and thus "midnight" is at 1:00 am while using daylight savings time! Jupiter was in opposition on October 25, 2011, when its coordinates were:

Time	RA (2000)	DEC (2000)	Ecliptic Longitude	Ecliptic Latitude
1:00:00	02 ^h 15 ^m 21 ^s	+11° 59' 54"	35° 48' 13"	01° 29' 05"
5:00:00	02 ^h 15 ^m 16 ^s	+11° 59' 38"	35° 46' 52"	01° 29' 05"

The ecliptic longitude and latitude are the geocentric values, i.e., the location along the ecliptic as seen from Earth. Jupiter changes its ecliptic longitude by $-81''$ while staying at constant ecliptic latitude. In equatorial coordinates, the motion is mostly to the west ($-5^s = -75''$) and somewhat south ($-16''$). Thus, Jupiter is moving westward along the ecliptic, that is, in the retrograde direction.

Q7. The Pleiades rise at sunset on November 13, 2011. They rise at about 10:30 pm EDT on September 1, 2011. Thus, they should be observable between sunset and midnight for the entire semester. Since they are more easily observed when higher in the sky, later in the semester is a better time for observing them. They are on the meridian at 11 pm on December 2, so this date is a good time to observe this cluster.

Q8. Jupiter starts out east of Sun along the ecliptic on March 1, 2011. As the days progress, you will notice that Jupiter moves from west to east with respect to the stars – prograde motion. Jupiter's motion is noticeably slower than that of the Sun and other planets. Jupiter is in *conjunction* with the Sun on April 6 and, after that date, is to the west of the Sun. Jupiter's prograde motion slows until about September 1, when it stops and reverses its direction, beginning its retrograde (east to west) motion. Recall from Question 6 above that Jupiter crosses the meridian at midnight on October 25; it is in *opposition* at this time, and in the midpoint of its retrograde motion loop. Around December 15 Jupiter ceases retrograde motion and returns to prograde motion. On March 1, 2012 it is east of the Sun, continuing to move in the prograde direction.