
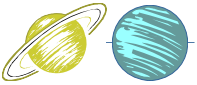


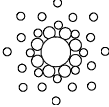



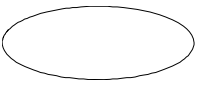



Q1.

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 sublime 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.
Lenticular Galaxy		AKA 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 ISM.

Q2. Mercury, Venus, and Mars are in Virgo, low in the west. Jupiter and Pluto (no longer officially a planet) are in Sagittarius, east of the meridian. Neptune is in Capricorn in the southeast. Uranus, in Aquarius, has not quite risen yet; it will appear at 7:19 on the eastern horizon.

### Q3. The Object Information for Sadr

Field	Value	Meaning
Type	Star	The object is a star
Magnitude	2.23	Apparent Brightness – visible in NJ skies!
Right Ascension	20 <sup>h</sup> 22 <sup>m</sup> 33.899 <sup>s</sup>	Equatorial E-W coordinate
Declination	+40° 17' 16.923''	Equatorial N-S coordinate
Azimuth	77° 08' 49''	Coordinate along horizon
Altitude	59° 48' 34''	Coordinate of elevation above horizon
Other Names	SAO 49528 GSC 3156:2223 HIP 100453 PPM 59799 HD 194093 B+39 4159	Smithsonian Astrophysical Observatory Catalog Hubble Space Telescope Guide Star Catalog Hipparchos Catalog (proper motion satellite) Positions and Proper Motion Catalog Henry Draper Catalog Bonner Durchmusterung Catalog
Flamsteed-Bayer	37-Gamma Cygni	Constellation name and brightness rank
Spectral	F8Ib	Spectral Type – late F supergiant
Proper Motion	RA 2.43 Dec -0.93	Motion across the plane of the sky, in milliarcseconds per year
Magnitudes	Bt 3.084 Vt 2.307	Apparent brightness in blue and visual (green)
Parallax	2.140 mas 467.3 pc	Apparent shift on sky due to Earth's orbital motion. Gives distance (1 pc = 206265 AU)
Distance	1524.10 ly 96385592 AU	Distance from parallax, in other units. Ridiculous number of significant figures in AU!
Magnitude	2.23	(again!)
RA	20 <sup>h</sup> 22 <sup>m</sup> 33.899 <sup>s</sup>	Equatorial coordinates (current epoch)
Dec	+40° 17' 16.923''	Equatorial coordinates (current epoch)
RA	20 <sup>h</sup> 22 <sup>m</sup> 13.702 <sup>s</sup>	Equatorial coordinates (2000 epoch)
Dec	+40° 15' 24.045''	Equatorial coordinates (2000 epoch)
Azm	77° 08' 49''	Coordinate along horizon (at specified time)
Alt	59° 48' 34''	Coordinate of elevation above horizon (at sp time)
Rise	12:45	Local Time object crosses our eastern horizon
Transit	21:55	Crosses meridian at 9:55 pm tonight
Set	07:08	Local Time object crosses our western horizon
Hour Angle	-02 <sup>h</sup> 39 <sup>m</sup> 59.9 <sup>s</sup>	Local sidereal time – object's right ascension
Air Mass	1.16	Secant of angle between zenith and object
Position error	0.56 mas	Coordinate uncertainty (in milliarcseconds)
From		Separation from last object clicked on.

Q4.

Star	Magnitude	RA	Dec	Sp Type
Arcturus	-0.05	14 <sup>h</sup> 16 <sup>m</sup> 03.4 <sup>s</sup>	+19° 08' 18.5"	K2IIIp
Antares	1.06	16 <sup>h</sup> 29 <sup>m</sup> 57.0 <sup>s</sup>	-26° 27' 11.9"	M1Ib
Vega	0.03	18 <sup>h</sup> 37 <sup>m</sup> 15.0 <sup>s</sup>	+38° 47' 42.8"	A0V
Altair	0.76	19 <sup>h</sup> 51 <sup>m</sup> 13.9 <sup>s</sup>	+8° 53' 36.5"	A7IV-V
Deneb	1.25	20 <sup>h</sup> 41 <sup>m</sup> 45.3 <sup>s</sup>	+45° 18' 53.8"	A2Ia
Fomalhaut	1.17	22 <sup>h</sup> 58 <sup>m</sup> 10.3 <sup>s</sup>	-29° 34' 24.7"	A3V
Capella	0.08	5 <sup>h</sup> 17 <sup>m</sup> 21.0 <sup>s</sup>	+46° 00' 21.6"	M1

Note that Capella does not rise until 9:10 pm on Sept. 11. Its visibility in the real sky depends on the date and time that you do the observation. 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. The stars of the summer triangle will be blue-white in color, in contrast to the red color of Arcturus (and Antares and Capella, if they are visible).

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 6:15 am, Uranus is near the western horizon, about to set. Saturn is above the eastern horizon, having risen a few minutes earlier.

Q6. Jupiter was in opposition on July 22, 2008, when its coordinates were:

Time	RA	DEC	Ecliptic Longitude	Ecliptic Latitude
0:00:00	19 <sup>h</sup> 08 <sup>m</sup> 22.4 <sup>s</sup>	-22° 44' 15"	285° 43' 23"	-00° 13' 32"
5:00:00	19 <sup>h</sup> 08 <sup>m</sup> 17.1 <sup>s</sup>	-22° 44' 24"	285° 42' 10"	-00° 13' 33"

Jupiter changes its ecliptic longitude by -73" while staying at almost constant ecliptic latitude (1" further south). In equatorial coordinates, the motion is mostly to the west (-5.3<sup>s</sup> = -73") and somewhat south (-9"). Thus Jupiter is moving westward along the ecliptic, that is, in the retrograde direction.

Q7. The Pleiades rise at sunset on November 17, 2008. They rise at 10 pm EDT on September 11, at 8 pm EDT on October 11, at 5 pm EST on November 11, and at 3 pm EST on December 12. This cluster can be observed during evening hours on any clear night of the semester, but they are more easily observed later in the semester (unless you are willing to stay up late). Objects need to be somewhat above the horizon for reasonable observing – about an hour or so. Thus in September, 11 pm would be the earliest that you would want to observe the Pleiades. In early December they are on the meridian at 11 pm – this is the optimal place to observe an object, since the effects of the atmosphere are least on the meridian.

Q8. Jupiter starts out just west of Sun along the ecliptic on January 1, 2008. 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. Around May 11 Jupiter reverses its motion with respect to the stars, and begins moving east to west – retrograde motion. Recall from Question 6 above that Jupiter crosses the meridian at midnight on July 22: it is in *opposition* at this time, and in the midpoint of its retrograde motion loop. Around September 7 Jupiter ceases retrograde motion and returns to prograde motion. On December 31 it is west of the Sun, continuing to move in the prograde direction.