

ASTR 2000 HOMEWORK #8 DUE: THURSDAY APRIL 14th

NAME: FRANCIS SCOTT **KEY**

1. (11 points total) Define or describe the terms below by highlighting their similarities and differences.

a). (2 points) The Zodiac constellations as contrasted with Zodiac signs. Explain why there is a difference.

Zodiac constellations are 12 astronomical star groupings along the ecliptic, each approximately but not exactly 30 degrees in width.

Zodiac signs are 12 theoretically equal regions of exactly 30 degrees along the ecliptic corresponding to locations of Sun in successive one month periods of the seasonal year.

Signs and constellations originally corresponded to each other (i.e., Sun was located “in” the constellation of Pisces during the month of year assigned to Pisces = 21 Feb—20 Mar; see Table 1) , but now differ approximately by one constellation due to the *precession of the equinoxes* which shifts the locations of stars relative to the seasons.

b). (2 points) A planetary conjunction. Describe the possible similarities and/or differences in the *phase* of Venus and the Moon when they are conjunct in the morning sky.

A planetary conjunction occurs when two or more planets appear to be close together on the sky; astrologically defined as within about 8 degrees on the sky. If Venus and the Moon are conjunct, then they have the same phase (it would be **waning crescent**) if Venus is closer to Earth than the Sun. If Venus is further away than the Sun, then we see Venus as gibbous or full phase when Moon is crescent.

c). (3 points) Astronomy and Astrology

Astronomy is the study of the physical nature of the objects in the heavens; it is a science which extends laboratory and theoretical understandings here on Earth to the heavens using the scientific method.

Astrology is the ages-old belief system that the appearance, location and motions of heavenly bodies determine or correspond to the basic nature, present circumstances and/or future happenings of individuals, groups and/or entire cultures. Astrology is guided philosophically by the Principle of Hermes: “As above, so below”.

d). (2 points) Define the Principle of Hermes (also called the “Hermitian Principle”) and explain why it is named after Hermes (Mercury).

The Principle of Hermes is the attempt of the ancients to create a “Grand Unified Theory” of heavens and Earth and is briefly stated as “As above, so below”, meaning that the heavens astrologically reflect the nature of Earthly things including human beings. It is named after Hermes (Mercury), because he is the messenger God between heavens and Earth and the planet Mercury is only seen just above the

eastern or western horizon and so is always hovering in the heavens close to the Earth's surface. That is, according to this principle the details of heavenly appearances, locations and motions are sending us messages about our circumstances, past, present and future.

e). (2 points) Explain what the God Mithras and the Mithraic Mysteries religion have to do with the precession of the equinoxes.

The Mithraic Mysteries was a religious belief system popular in the Roman army around the time of Christ. The God Mithras was taken to be so powerful that he could move the Earth, a clear reference to the *precession of the equinoxes*, which moves the Earth relative to the sky causing e.g., the location of the Sun at equinox dawn to move from one constellation to the next. At about 2000 BCE the Sun no longer rose in Taurus at equinox dawn. Thus according to Mithraic symbology "Mithras slays the Bull" and the principal Mithraic ritual was the slaying of a Bull, a "Tauroctony", it is called. The secret knowledge of the Mithraic Mysteries appears to be the ritualization of the *precession of the equinoxes*.

2. (9 points total) Choose the constellation which is the astronomical counterpart to your astrological "Sun sign". That is, the astrological sign which the Sun was in when you were born. My birthday is: 6th of February
My "Astrological Sun sign" is: Aquarius

a). (3 points) In the space below sketch the appearance of your Sun sign zodiac constellation as it appears in the sky when it crosses the meridian (star charts are posted for your use if needed under homework #8 on the class website). Distinguish the brighter and dimmer stars with larger and smaller dots respectively. Name any very bright (First magnitude) stars in your Sun sign constellation.

Aquarius the Water Bearer or "Flood survivor".

See star chart; no bright stars at all are present in this constellation. .If you are in quite a dark location, you can see small groupings of faint stars which "cascade" like flowing water away from the brighter 3 or 4 stars which outline the water jug.

b). (3 points) At what time of the year would your constellation be visible in the early evening hours (approximately one hour after dark)? Where in the sky would you look for your constellation at that time? Briefly describe how you would locate this constellation in the sky.

Generically, since these stars are (one constellation removed {due to the precession} from) the constellation where the Sun is located on my birthday, Aquarius would NOT be seen in the sky on my birthday due to being up during the day. Aquarius would be seen crossing the meridian near midnight 6 months later; late summer in this case. A little later in the year Aquarius would be seen in the early evening.

In late summer I would look to the south east around 1—2 hours after sunset (Aquarius is just south of the Celestial Equator; see star chart; and so rises south of east and stays relatively low in the sky during the night). I would look higher in the sky and spot the "Great Square of Pegasus" the look lower in the sky and to the west of Pegasus to find the "smile" of Capricorn. Both of these constellations have brighter stars than Aquarius; see star chart where I have shaded these constellations. Aquarius is located

between these two constellations. It is also just above the bright star Fomalhaut, a 1st magnitude star I have marked with a box . **See star chart.**

{While this description is specific to Aquarius, I expect you to use brighter and easier to find constellations to locate your zodiac constellation nearby in a similar manner. Find it in the SKY so you can show your friends!}.

c). (3 points) Use the remainder of this page to describe some of the "lore" of your Sun sign constellation. The book "The Secret Language of the Stars and Planets" gives the Greek/Babylonian view. "Stars of the First People" gives an alternative Native American view to many of these constellations. Both are on reserve at the Math-Physics Library.

In Greek mythology Aquarius may be identified with Ganymede, the cupbearer of the Gods. But in most renditions this constellation is associated with the great floods which may be a secret, esoteric description of the precession. In some discussions the cup and out-flowing water represents the origin of the Nile, and thus of all life in the ancient reckoning.

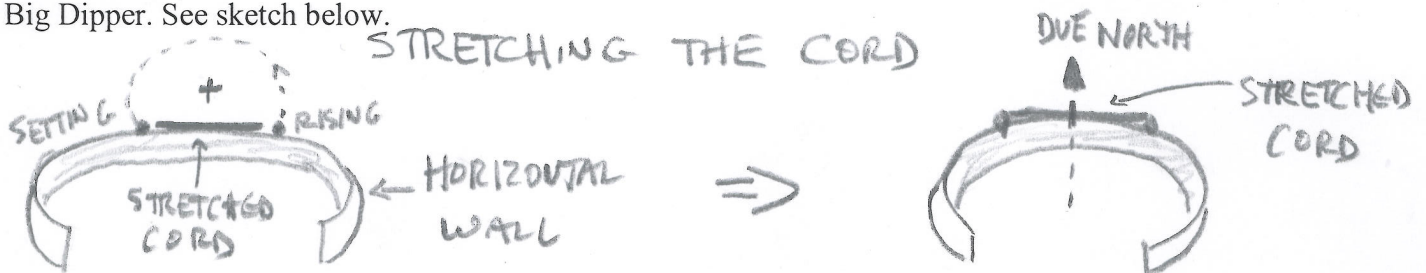
It is also important to acknowledge the modern mythology of the "age of Aquarius", the new age of consciousness that esoterics claim will be ushered in when the precession of the equinoxes moves the Sun at equinox dawn into the constellation of Aquarius. This is predicted to occur sometimes in the next two hundred years.

3. (11 points total) The Great Pyramids at Giza are the only remaining member of the Seven Wonders of the Ancient World. Besides the remarkable engineering feat and cooperative effort required to construct these marvels, the accuracy with which the sides of the pyramids are aligned north-south-east-west is astounding (< a few arc-minutes, where 1 arc-minute = 1/60th of a degree)!

a). (4 points) Due to some very recent investigations there is now some controversy about the method used to align the Pyramids to the cardinal directions so accurately. Most hypotheses for the precise alignment of these pyramids call for an astronomical method called "stretching the cord". However, Kate Spence of Cambridge U. has suggested another method involving observing so-called "meridian pairs" or "simultaneous transit" stars. Explain the astronomical basis for these two different methods. Make sure you define the terms "stretching the cord" and "meridian pairs" in your answer.

Stretching the cord technique uses circum-polar stars. The idea is that since these stars appear to move on perfect circles around the North Celestial Pole each night due to the exact circular rotation of the Earth on its axis. A horizontal wall can be used to mark rising and setting points of the same circum-polar star on the wall. A cord is "stretched" between these two positions and the halfway point marked. A sight-line from the observer to this halfway location points due north. See sketch below.

The meridian pair method uses pairs of stars which cross the meridian at exactly the same time and so are vertical when they are due north. A measuring tool like a plumb bob can be used to determine when these stars are exactly vertical. An example at the current time are the so-called "pointer stars" of the Big Dipper. See sketch below.



MERIDIAN PAIRS:

NCP

LATER
THAT NIGHT →
[STARS NO LONGER
VERTICAL ⇒ NOT
TO NORTH

NCP

b). (3 points) Which of these methods (one or both?) are affected by the precession of the equinoxes? Explain why the new evidence presented by Spence favors the meridian pair method.

Stretching the cord method is NOT affected by precession since at any one time in history, any circumpolar star would still make an exact circle around the North Celestial Pole; i.e., precession is a VERY SLOW movement. Different stars would be used at different times in history but this method would always mark due north accurately.

The meridian pair method IS affected by precession since the locations of stars are shifted relative to the North Celestial Pole; e.g. precession moves some stars closer to and some stars further away from the North Celestial Pole. For example, in circa 2500 BCE the North Celestial Pole was near the medium bright star Thuban, not Polaris and so the Big Dipper "pointer stars" did NOT point to the North Celestial Pole and so were NOT a meridian pair. See sketch below.

THUBAN • NCP

IN C. 2500 BCE
POINTER STARS ARE EAST OF
NORTH WHEN THEY ARE
VERTICAL

c). (3 points) A few Egyptologists suggest that the Sphinx was not built during the same era as these Great Pyramids (circa 2500 B.C.E.) but rather at a MUCH earlier time. This speculation is based upon the resemblance between the Sphinx and a Lion, suggesting to some (mostly amateur) Egyptologists that the Sphinx was aligned with the constellation Leo when it rose heliacally at Equinox dawn.

To what exact direction does the Sphinx face, given that it faces a zodiac constellation rising at equinox dawn? Explain.

Equinox dawn: Sunrise due east no matter what the latitude → Sphinx faces due east

What zodiac constellation rose heliacally on the Spring equinox when the Great Pyramids were built (circa 2500 BCE)?

2500 BCE was during late stages of the "Age of Taurus" (see notes page 100) → **Taurus**

Approximately in what century would the Sphinx have been constructed to align with the heliacal rise of the constellation of Leo at the Spring Equinox?

In Table 1 below you can see that Leo is 3 constellations over from Taurus. Precession moves the equinox sky one constellation every ~ 2000 years (2160 years from the previous homework). If we take the mid-point of the Age of Taurus to be c. 3000 BCE then the time when Leo would be the equinox constellation would be ~ 3 x 2000 = 6000 years earlier or circa 9000 BCE.

[*** It is important to note that this idea is NOT held correct by most Egyptologists and is based at least partly on the Sphinx having the body of a lion. But it also has the face of a human being that most scholar identify with Khafre, the son of Khufu, builder of the Great Pyramid in c. 2500 BCE}

FOR YOUR USE FROM A PREVIOUS HOMEWORK:

Table 1: The Babylonian/Greek Zodiac

| Constellation Name | Depiction | Sun in Constellation | Astrological Month | Visible in Early Evening |
|--------------------|--------------|----------------------|--------------------|--------------------------|
| SUN's location : | | TODAY (2000 CE) | in 0 CE | |
| Pisces | Two Fishes | 21 Mar – 20 Apr | 21 Feb – 20 Mar | Fall |
| Aries | Ram | 21 Apr – 20 May | 21 Mar – 20 Apr | Fall/Winter |
| Taurus | Bull | 21 May – 20 June | 21 Apr – 20 May | Winter |
| Gemini | Twins | 21 June – July 20 | 21 May – 20 June | Winter |
| Cancer | Crab | 21 July – 20 Aug | 21 June – 20 July | Winter/Spring |
| Leo | Lion | 21 Aug – 20 Sept | 21 July – 20 Aug | Spring |
| Virgo | Maiden | 21 Sept – 20 Oct | 21 Aug – 20 Sept | Spring |
| Libra | Scales | 21 Oct – 20 Nov | 21 Sept – 20 Oct | Summer |
| Scorpio | Scorpion | 21 Nov – 20 Dec | 21 Oct – 20 Nov | Summer |
| Sagittarius | Centaur | 21 Dec – 20 Jan | 21 Nov – 20 Dec | Summer |
| Capricorn | Sea Goat | 21 Jan – 20 Feb | 21 Dec – 20 Jan | Summer/Fall |
| Aquarius | Water Bearer | 21 Feb – 20 Mar | 21 Jan – 20 Feb | Fall |