ASTR 2000 HOMEWORK #3 DUE THURS SEPT 22nd NAME: _____

1. SETTING AN ACCURATE CALENDAR USING OBSERVATIONS OF THE SUN

A. Many ancient peoples created and maintained a calendar based upon the Sun (and thus the seasons). In order to maintain the accuracy of a solar calendar, specific **OBSERVATIONS** of the Sun were made. Different ancient cultures used different methods largely due to their different geographical locations on the Earth (either local topography or terrestrial latitude, or both). By considering various ways in which this was done, list three (3) **DIFFERENT METHODS for OBSERVING** the Sun to set the calendar.

B. Choose one of the methods you listed above and pick an ancient culture which used this method to set its calendar or time its ceremonies. In the space provided below, write a paragraph describing how this method was used by this culture for this purpose and why the geographical location of this culture made this the best method. BE AS SPECIFIC AS POSSIBLE IN YOUR DESCRIPTION.

C. Very early (circa 2000 B.C.E.)in Babylonia and Egypt, calendars were kept which used BOTH the Sun (and thus the seasons) AND the phases of the moon. For such a calendar to "work", each new year would have to begin at the same lunar phase. Explain why this doesn't work in the long-term and say how quickly (be quantitative) a lunar calendar would get "out of step" relative to a solar calendar. {If you wish you can answer by giving the number of days that would have to be inserted into or deleted from a lunar calendar to keep it in step with a solar calendar}. SHOW YOUR WORK!

Helpful numbers: length of Tropical year: 365 ¼ days
Length of lunar synodic period (cycle of phases): 29 ½ days

2. The tropics on the Earth are the latitudes where the Sun can be seen to cross exactly through the zenith on at least one day of the year.

a). What are the latitudes of the tropics and how is this related to the tilt of the Earth's pole in space relative to the ecliptic?

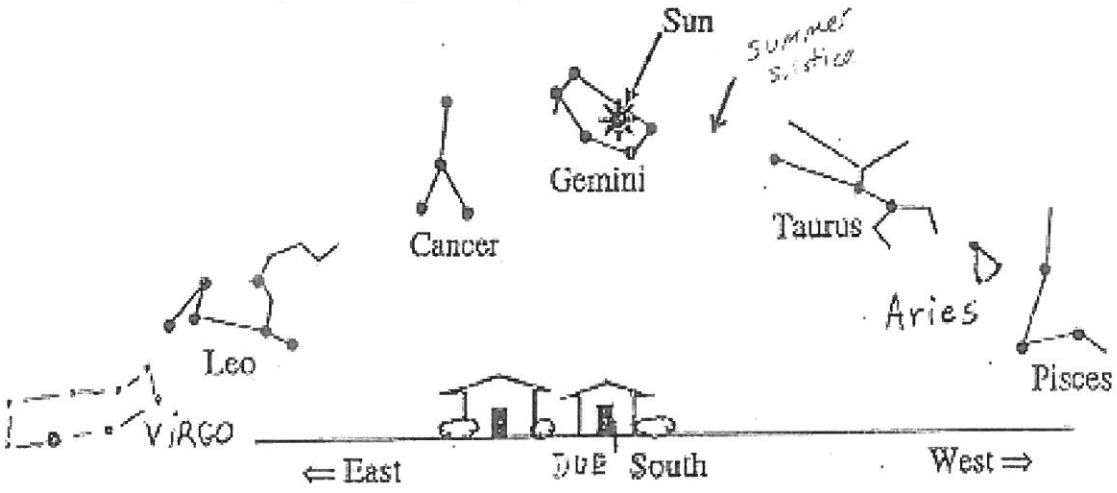
b). Hawaii is the only American state in the tropics since it is at 20 degrees North latitude. The chart on the next page shows the "zenith passage" days for locations at different latitudes. Explain what is meant be a "zenith passage" day and use this chart to determine how long the Sun stays north of the zenith at noon as seen from Hawaii.

c). The "classic" Maya civilization flourished from 500-1000 AD and lived at 15 degrees north latitude in parts of southern Mexico and northern Central America. The Maya used precisely vertical tubes of stone to observe quite accurately the zenith passage days for the purpose of setting their Solar calendar (called the "Haab"). Why can't we use this method to set our calendars here in Boulder?

ZENITH PASSAGE DATES OF THE SUN FOR OBSERVERS AT DIFFERENT LATITUDES

LATITUDE	DATE(S)	NUMBER OF DAYS SUN IS: NORTH/SOUTH OF ZENITH
23.5 North	June 22	1/ 364
20 North	May 21, July 24	64/ 301
15 North	May 1, Aug 12	103/ 262
10 North	Apr 16, Aug 28	134/ 231
5 North	Apr 3, Sep 10	160/ 205
Equator	Mar 21, Sep 21	184/ 181
5 South	Mar 8, Oct 6	212/ 153
10 South	Feb 23, Oct 20	239/ 126
15 South	Feb 8, Nov 3	268/ 97
20 South	Jan 21, Nov 22	305/ 60
23.5 South	Dec 21	364/ 1

3. If you could see stars during the daytime, this is what the sky would look like on a certain day looking due south from Boulder. The Sun is "in" the stars of the constellation of Gemini at noon. For the purpose of this homework assume that each zodiac constellation is *exactly 30° along the ecliptic.*



a). The location of the Summer Solstice Sun is marked with an arrow. What is the **approximate date** (day and month, not year) of the depiction on the previous page? Explain.

b). At what time of year would the stars of Gemini be visible crossing the local meridian at midnight? Explain.

c). On the day depicted above, it is the night of a waxing crescent Moon. Locate the approximate position of the crescent Moon on the sketch above part (a) above, sketch the appearance of the waxing crescent at that location and describe when this Moon would be visible in the sky and where.

d). One month later it is again a waxing crescent Moon. Using arrows labeled *S for Sun* and **M for Moon**, locate the Sun and Moon on the sketch above part (a) above.

e). Has the Moon moved more than, less than or exactly 360° relative to the stars between the time specified in part (c) and the time specified in part (d) ? Explain.