

Optional Homework

ASTR 2000 HOMEWORK #5 DUE THURS OCT 6th NAME: _____

1. Solar eclipses are one of the most awesome of human experiences.

A. In the space below draw the geometry of an eclipse of the Sun (i.e., the relationship between the Sun, Moon and Earth as viewed from well away from the Earth), labeling each object in your drawing, and including the darkest (umbra) and less dark (penumbra) parts of the shadow. Place a "T" at a typical place where the eclipse is total and a "P" at a place where the eclipse is partial.

B. Explain using another drawing why solar eclipses do not occur every month when the moon is new.

C. Now please look at Table 4 on the front side of the last page which lists all the eclipses (i.e., both lunar and solar; both total and partial) which occurred in the 1980s. Notice the third column, which tabulates the number of days from the listed eclipse until the next eclipse.

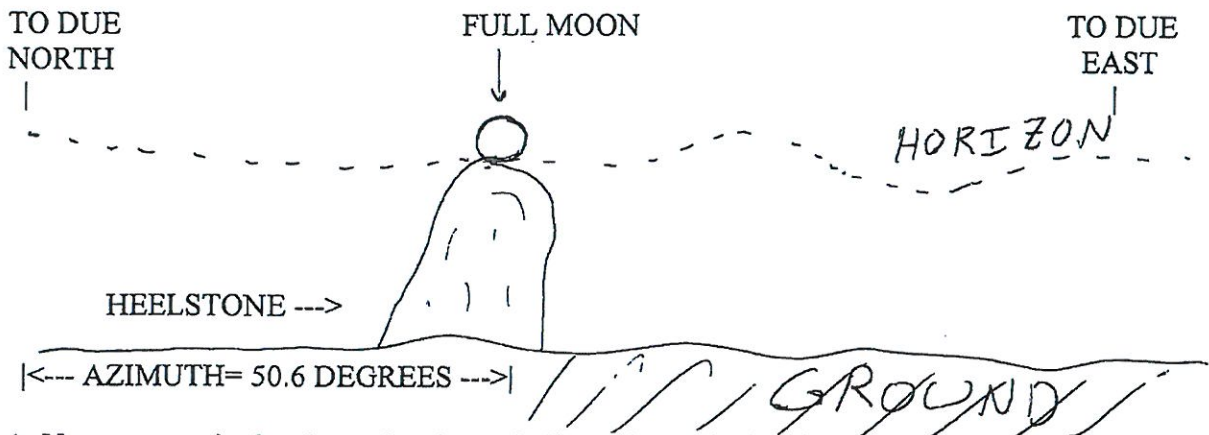
(1). Notice that the same numbers occur again and again. Note specifically, that almost every year (excepting 1980 & 1984), a lunar or solar eclipse is followed by the other type of eclipse just 14-16 days later. Explain why this occurs so frequently, especially considering the "regression (i.e., backwards = east-to-west movement) of the lunar "nodes."

(2). The other numbers which recur frequently in column 3 of Table 4 corresponds to intervals of 5, 5 1/2 or 6 moons. Explain why these intervals recur, again using your knowledge of the lunar nodes. Make sure your answer includes why these intervals aren't exactly centered on one half year exactly (i.e., why intervals are not at 5 1/2, 6 and 6 1/2 moons?).

(3). Shown on the backside of the last page is a portion of the number "glyphs" (word pictures) on page #53 of the Dresden Codex, one of the 4 remaining Mayan books which is named after the European city in which it was "rediscovered". Given the numbers you see in this Table at right, what do you think the Maya were doing? Explain in your answer how sound you think this reasoning is and why.

2. At the Mid-Winter Full Moon (that full moon closest to the Winter Solstice, but not exactly on Dec 21st), an archaeo-astronomer visiting Stonehenge (latitude 51 degrees north) notices the precise alignment of the Full Moon and the Heelstone as shown below:

*** VIEW IS TO THE NORTH-EAST COVERING 90 DEGREES NORTH THROUGH EAST



A. Use an arrow in the above drawing to indicate the angle that the Moon will rise away from the Heelstone. How much is amount of that angle as measured down from the vertical? Explain.

B. This particular Full Moon is located EXACTLY on the ecliptic plane (it is rising exactly over the heelstone 180 degrees away from the Sun). What is the ecliptic plane? Describe where the Sun will rise the next morning on the sketch above?

C. Is the Mid-Winter Full Moon always on the ecliptic plane? If not, how often is the Mid-Winter Full Moon exactly on the ecliptic plane? Explain

D. What astronomical event occurs when the Mid-Winter Full Moon is on or quite close ($< 1/2$ degree) to the ecliptic plane? Explain

The below question will not be graded

3. We have seen from examples in class that ancient civilizations that were settled in cities and had hierarchical “class” social structures also had experts who knew very detailed information about the sky (e.g., Egyptian, Babylonian, Ancestral Pueblos, Maya, Inca). For these cultures we see plenty of physical evidence in either written knowledge (e.g., Babylonian cuneiform tablets, Maya codices, etc) or in building or monument orientations or “light shows” (e.g., The Chaco Sundagger, Stonehenge, the Giza Pyramid alignments, the Newgrange passage tomb, the Mortuary Temple of the Pharaoh Amenhotep III at Thebes, etc etc) of this astronomy.

Other cultures were more nomadic (e.g. Lakota, Navajo, Aboriginal Australian, people of Nabta Playa) or left no written records of their knowledge (e.g., Inca) and/or no buildings (e.g., Chumash, Australian Aboriginals) showing explicitly their astronomical knowledge. We might know very little of what they knew about the sky except for the remaining knowledge of tribal elders that comes down to us in the present day through a strong oral tradition.

OVER TO THE NEXT PAGE FOR QUESTIONS:

a). Make up a fictional ancient culture of your own devising describing them in terms of where on the Earth they lived and which of the above two types of cultural categories they fit into. Describe this culture briefly including characteristics you think might bear on their astronomy.

b). For this fictional culture describe a likely calendar that they might use. How would they set and re-set their calendar. Is their calendar: Solar, Lunar or Luni-solar and why?

c). For this fictional culture describe their likely relationship with the Sun and Moon; which of these two heavenly bodies is more important in their cosmology and why?

Referred to in Question # 1 PART C.

Table 4. Eclipses of the Sun and Moon during the 1980s

Date	Type	Number of Days to Next Eclipse	Phase	Region of Visibility of Annular or Total Solar Eclipses†
1980 Feb. 16	Solar	176	Total	North Atlantic, Central Africa, India, China
Aug. 10	Solar	178	Annular	Central Pacific, Central South America
1981 Feb. 4	Solar	163	Annular	South Pacific
Jul. 17	Lunar	14	Partial	
Jul. 31	Solar	162	Total	Caspian Sea, Siberia, North Pacific
1982 Jan. 9	Lunar	16	Total	
Jan. 25	Solar	147	Partial	
Jun. 21	Solar	15	Partial	
Jul. 6	Lunar	14	Total	
Jul. 21	Solar	148	Partial	
Dec. 15	Solar	15	Partial	
Dec. 30	Lunar	163	Total	
1983 Jun. 11	Solar	14	Total	South Indian Ocean, Malaysia, New Zealand
Jun. 25	Lunar	162	Partial	
Dec. 4	Solar	178	Annular	North Atlantic, Central Africa
1984 May 30	Solar	175	Total-Annular*	Central Pacific, Northern Mexico, Southern United States, North Atlantic, North Africa
Nov. 22	Solar	163	Total	New Zealand, South Pacific
1985 May 4	Lunar	15	Total	
May 19	Solar	162	Partial	
Oct. 28	Lunar	15	Total	
Nov. 12	Solar	148	Total	South Pacific, Antarctica
1986 Apr. 9	Solar	15	Partial	
Apr. 24	Lunar	162	Total	
Oct. 3	Solar	14	Total	Greenland, Iceland
Oct. 17	Lunar	163	Total	
1987 Mar. 29	Solar	178	Total-Annular*	Southern South America, South Atlantic, Central Africa
Sep. 23	Solar	14	Annular	Central Asia, China, South Pacific
Oct. 7	Lunar	163	Partial	
1988 Mar. 18	Solar	162	Total	Malaysia, Coastal East Asia, Aleutian Islands
Aug. 27	Lunar	15	Partial	
Sep. 11	Solar	162	Annular	West Africa, South Indian Ocean, Australia
1989 Feb. 20	Lunar	15	Total	
Mar. 7	Solar	163	Partial	
Aug. 17	Lunar	14	Total	
Aug. 31	Solar		Partial	

* Total for part of the path and annular for the remainder.
 † All other eclipses visible over a much wider area.

NECESSARY TABLE FOR QUESTION #1 PART C(3) ON PAGE #2 OF HOMEWORK #5

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(3). Shown below is a portion of the number "glyphs" (word pictures) on page #53 of the Dresden Codex, one of the 4 remaining Mayan books which is named after the European city in which it was "rediscovered". Given the numbers you see in this Table at right, what do you think the Maya were doing? Explain in your answer how sound you think this reasoning is.

EXCERPT FROM DRESDEN CODEX

# in codex ↓	accumulating # ↓	# in codex	accumulating # ↓
177	177	178	6,585
177	354	177	6,762
148	502	177	6,762
Picture		177	6,939
177	679	177	7,116
177	856	148	7,264
177	1,033	Picture	
178	1,211	177	7,441
177	1,388	177	7,618
177	1,565	177	7,795
177	1,742	177	7,972
177	1,919	177	8,149
177	2,096	277	8,326
148	2,244	148	8,474
Picture		Picture	
178	2,422	177	8,651
177	2,599	177	8,828
177	2,776	178	9,006
177	2,953	177	9,183
177	3,130	177	9,360
148	3,278	177	9,537
Picture		177	9,714
177	3,455	177	9,891
177	3,632	148	10,039
177	3,809	Picture	
177 (178)	3,986	177	10,216
177	4,163	178	10,394
177	4,340	177	10,571
148	4,488	177	10,748
Picture		177	10,925
177	4,665	177	11,102
177	4,842	148	11,250
178	5,020	Picture	
177	5,197	177	11,427
177	5,551	177	11,781
177	5,728	177	11,958
177	5,905		
177	6,082		
148	6,230		
Picture			

← TOTAL # of days
≈ 33 years
in Table