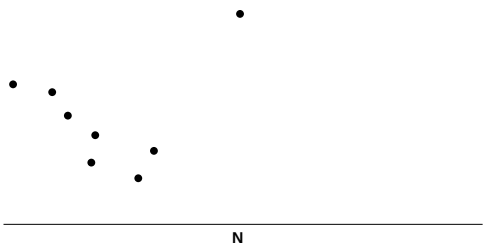
Except for questions 17, 18, 19, 21, 32 marks/answers on these sheets are not graded.
Record your answers on your answer sheets unless the question states otherwise!

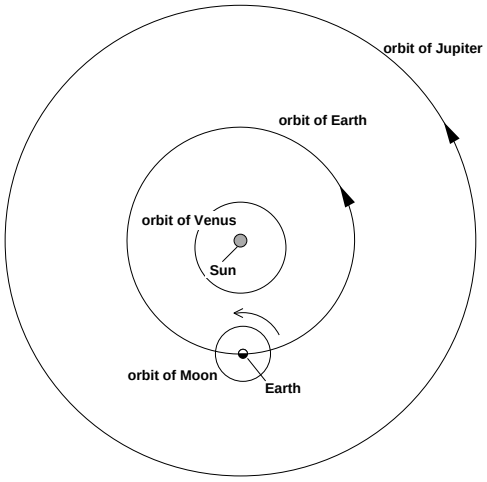
Answer *TRUE* or *FALSE* (<u>not</u> *T* or *F*) (2 pts each)

1. If SI units (the "metric system") are being properly used the "Megamall" is a billion times bigger than a normal mall.
2. Every vertical circle passes through the observer's zenith.
3. *Altitude* is the angle between a star and the celestial equator.
4. On the equator (latitude=0°) the Sun will go through zenith every day.
5. The changing direction of the Earth's axis (the axis pointing in different directions during the year), is the primary cause of the seasons.
6. The far side of the Moon is continuously dark.
7. The synodic period of the Moon is the time from full Moon to full Moon.
8. At the time of a lunar eclipse the Moon enters the shadow of the Earth.
9. Generally the Moon is a bit above or below the ecliptic. It is only on the ecliptic if it is at one of the two *nodes*.
10. An inferior planet in superior conjunction to the Sun will be on the meridian at about noon.
11. Copernicus and Luther were alive at the same time.
12. Ptolemy was born before St. Benedict.
13. Newton's second law states that the speed of an object is proportional to the force and inversely proportional to its mass.
14. A satellite orbiting the Earth in a circle at a constant speed <u>**is**</u> accelerating.
15. Since the Earth is more massive than the Moon, the gravitational force of the Earth on the Moon is greater than the gravitational force of the Moon on the Earth.
16. The force of gravity on an orbiting astronaut is *tiny* (i.e., much less than it is on the surface of the Earth).

Give a short explanation (5 pts each)

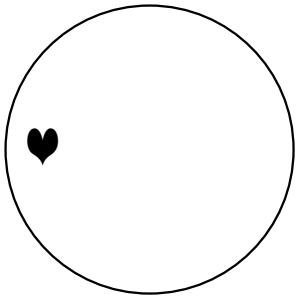
17. The below right cartoon shows (not to scale) the orbits of Jupiter, Earth & Venus as seen from a fixed point high above the Earth's north pole. The arrows show which way the planets go around the Sun (which is also the way the Earth spins). This year on Christmas, the Moon will be Full, Venus will be Gibbous (about 75% white) visible in the morning sky, and Jupiter will start its retrograde motion in 2 weeks (8-Jan-2016). Directly on the below diagram display the Christmas location of these objects: mark "L" on the diagram at the location on Christmas of the Moon, "V" at the location of Venus, and "J" at the location of Jupiter. Mark with the symbol "♃" the location of Jupiter on 8-Feb-2016.



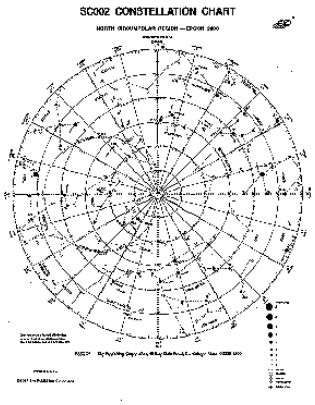


18. Consider the above left cartoon of a 9 P.M. view looking north at CSB/SJU. Directly on top of this picture (using the same horizon), sketch what the view would look like 6 hours later.

19. The below left is a (mostly empty) sky map for CSB+SJU. Directly on this sheet sketch and label: meridian, north celestial pole, due east horizon. Assume the heart is a star pattern in the sky. Draw on your answer sheet a horizontal line representing the horizon and place a heart above your line showing how you would see this star pattern oriented in the sky.



20. Consider the (re-touched) photocopy of your Star Locator shown above right. Redraw on your answer sheet the Star Locator's oval that represents the sky and clearly label where the following are found: zenith, meridian, north celestial pole, celestial equator and the east point on the horizon.



21. Consider the copy (see right) of your SC002 star map. Directly on this sheet clearly label: a diurnal circle, an hour circle and the north celestial pole. Draw an arrowing showing how the map would rotate if it were matching the rotation of the celestial sphere.

22. On 30 September 2009 (six years ago) Saturn had R.A. = 11^h50^m and declination = $+3°$; Today Saturn has R.A. = 15^h56^m and declination = $-19°$. I want you to use this data to figure out how long it takes Saturn to complete a circuit around the celestial sphere. Towards this goal answer the following questions:

    (a) Through how many hours of RA has Saturn moved during the last 6 years? Round your answer to a whole number of hours of RA.

    (b) Given that Saturn has gone the above number of hours in six years, how many years would it take Saturn to go 24 hours of RA, i.e., all the way around the celestial sphere?

    (c) It turns out this calculation is about 20% high. What can we conclude about Saturn's RA motion?

23. Explain why the stars seen at night during the winter differ from those seen at night during the summer.

24. The Moon was in full phase Sunday (27-Sep-2015). Estimate when we will again see the Moon at sunset. Halloween is 5 weeks less one day (34 days) after Sunday's full phase. What phase will the Moon have on Halloween? Clearly explain *at what time* and *where in the sky* you could see the Moon on Halloween.

25. Identify an important contribution of each of the following people: Copernicus, Tycho, and Kepler.

26. Describe two of Galileo's telescopic observations that provided evidence supporting the Copernican theory. In each case report exactly how the observation contradicted the Ptolemaic theory.

27. Draw a picture of an orbit around the Sun with a large eccentricity. Label the position of Sun. Add to your diagram (and clearly label "small e") another orbit about the Sun with a smaller eccentricity. Which or your orbits has the longer period?

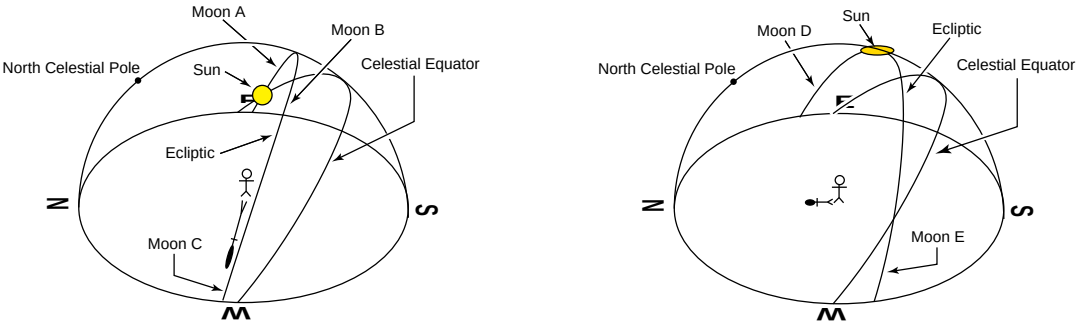
28. State two of Newton's "four" laws of motion.

Write out a complete answer (10 pts each)

29. Athens, Greece has a latitude of about 38°N and a longitude of about 24°E. On 21-Dec-2015 the planet Venus will have a right ascension of $15^h\,11^m$ and a declination of $-15°$. Report the time of day (on that date) when Venus crosses the meridian and its altitude at Athens (you must report your reasoning to receive any credit). Is Venus visible at sunrise? sunset?

30. Describe the cause of the seasons. What exactly causes it to be hot during our summers and cold during out winters? What solar characteristic defines "the Tropics" on Earth? What solar characteristic defines Polar Circles on Earth?

31. Consider the below diagrams of the dome of the sky which show the location of the Sun and possible positions for the Moon. For each possible position of the Moon you are to draw what the Moon would look like to the stick figure (i.e., a person on Earth). Thus for each of the five Moon positions, you should draw a horizontal line representing the horizon and a shaded circle representing the Moon. Show and label which parts of the Moon would be bright and which parts would be dark. In the left diagram the Sun is rising in the east and Moon positions A, B, and C are spread across the sky from east to west. In the right diagram it is noon; Moon position D is in the east and Moon position E is in the west.



32. Consider the below (re-touched) photocopy of your SC001 star map. Directly on the below diagram clearly label where the following are found: celestial equator, ecliptic, point of R.A.=0 (spring equinox), a hour circle and a diurnal circle. Finally display and label the location on 21-Dec-2015 of the Sun, Moon, Venus, Jupiter, and Saturn. (Questions 17, 22, and 29 may be of use.)