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

1. Every hour circle passes through the celestial poles.
2. On the Earth's equator (latitude=0°) the celestial equator is a vertical circle.
3. The declination of the star Dubhe (in the Big Dipper) is about 62°, so it should take a bit more than a hand plus a fist to reach the star Polaris.
4. A planet in conjunction with the Sun will culminate at about noon.
5. A star on the meridian tonight at 9 P.M. will be east of the meridian at 9 P.M. a month from today.
6. The larger the magnitude, the brighter the star.
7. The far side of the Moon is continuously dark.
8. The Moon follows roughly the same path on the Celestial Sphere as does the Sun, but it moves about 12 times faster and has retrograde loops at every opposition.
9. The sidereal period of the Moon is shorter than the synodic period of the Moon.
10. If in the morning the Sun is in the constellation Taurus, by the afternoon it would have moved on past the constellation Cancer.
11. At the time of a solar eclipse the Earth enters the shadow of the Moon.
12. 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*.
13. An astronaut living in the crater Copernicus (on the near side of the Moon) would see a "new Earth" if folks on Earth see a "full Moon".
14. The changing direction of the Earth's axis (the axis pointing in different directions during the year), is the primary cause of the seasons.
15. Copernicus was born a before St. Benedict.
16. A satellite orbiting the Earth in a circle at a constant speed is not accelerating.
17. 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.
18. The force of gravity on an orbiting astronaut is *tiny* (i.e., much less than it is on the surface of the Earth).
19. If the radius of the Sun were to double (with the mass unchanged) there would be no change in the gravitational attraction between the Earth and the Sun.
20. The Sun subtends an angle of about $\frac{1}{2}^\circ$ as seen from Earth. At perihelion the angle would be a bit less; at aphelion it would be a bit more.

Give a short explanation (5 pts each)

21. You observed (on a class field trip) that the phase of the Moon matched that of a ball located in the same direction as the Moon but held at arms length. Draw an arrangement of the Solar System where such a ball's phase and Venus' phase would not match. Draw an arrangement of the Solar System where the Moon's phase and Venus' phase do match, but they are not located in the same direction.

22. What is the maximum altitude that the Sun achieves here at CSB/SJU on December 21? On September 21?

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

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

25. Draw a picture showing the relative positions of the Sun, Moon and Earth during a lunar eclipse. Explain why solar and lunar eclipses often occur just a couple of weeks apart.

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

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.

29. Going around in a tight circle in a car, you are forced to grab the car door handle to remain in your seat. Why? Draw a picture showing the situation as seen from high above the car. Show and label: (A) direction of the turn, (B) the direction of any horizontal forces acting on you, and (C) the direction you would go if there were no forces acting on you.

30. The Moon will be in full phase on 4-Oct-2009. What will be the Moon's phase on Halloween (31-Oct-2009)? Clearly explain *when* and *where in the sky* you could see the Moon on Halloween.

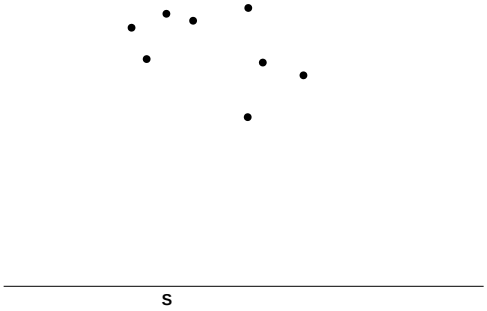
31. When Pluto was discovered on 18-Feb-1930 it was at RA=7^h21^m (in Gemini). 80 years later on 18-Feb-2010 Pluto will be at RA=18^h20^m (in Sagittarius). I want you to use this data to figure out how long it takes Pluto to complete a circuit around the celestial sphere. Towards this goal answer the following questions:

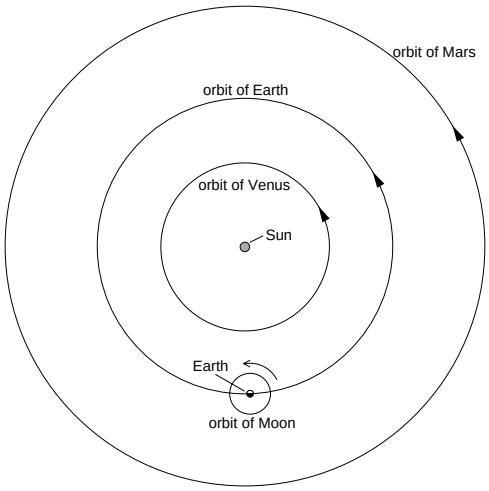
    (a) Through how many hours of RA will Pluto move in 80 years? Round your answer to this question to a whole number of hours of RA.

    (b) Given that Pluto has gone the above number of hours in 80 years, how many years would it take Pluto to go 24 hours of RA, i.e., all the way around the celestial sphere?

    (c) It turns out your answer is too short by about 75 years. What could go wrong? (Hint: Pluto was at perihelion on 3-Sep-1989.)

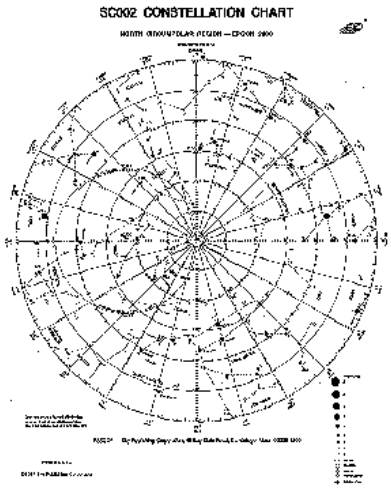
32. The below right cartoon shows the inner (Mars & in) Solar System as seen from a distant point high above the Earth's north pole. The arrows show which way the planets go around the Sun (which is also the way the Earth spins). At stated above, the Moon will be full on 4-Oct-2009. Further Venus will be a 'morning star' on 4-Oct-2009. Mars will move into opposition on 29-Jan-2010. Directly on the below diagram, map the Solar System as it will be on 4-Oct-2009. Write a "L" to denote the location of the Moon, a "V" to denote the location of Venus, and a "M" to denote the location of Mars.





33. Consider the above left cartoon of a 9 P.M. view looking south at CSB/SJU. on 1-Sep. Directly on top of this picture, sketch what the view would look like 3 hours later.

34. The below left is a strangely oriented sky map for February nights. On this sheet of paper, find and label the cardinal directions north, south, east, west, zenith. Label the location of the north celestial pole.



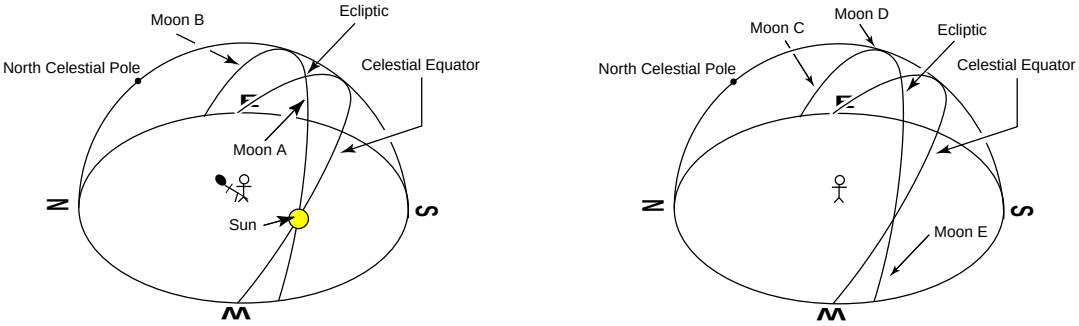
35. Consider the above right copy of your SC002 star map. Directly on this sheet clearly label: a diurnal circle, an hour circle and the north celestial pole.

Write out a complete answer (10 pts each)

36. Ankara, Turkey has a latitude of about 40°N and a longitude of about 30°E. On the April 21 the planet Mars will have a right ascension of $08^h\,48^m$ and a declination of 20°. Report the time of day (on April 21) when Mars crosses the meridian and its maximum altitude at Ankara (you must report your reasoning to receive any credit).

37. The space shuttle can "orbit" the Earth, i.e., not fall down, for a long time. How does that work? What exactly is needed? Astronauts in the space shuttle float, i.e., nothing seems to hold them down. How does that work?

38. 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). For each Moon position, draw a horizontal line representing the horizon and a shaded circle representing the Moon. Label which parts of the Moon would be bright and which parts would be dark. In the left diagram the Sun is setting in the west and Moon positions A, and B are spread across the sky from west to east. In the right diagram it is midnight so the Sun is not above the horizon; Moon position C is in the east, Moon position D is on the meridian, and Moon position E is in the west.



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

40. Mars will move into opposition on 29-Jan-2010. At that time Mars and a nearly full Moon will both be in the constellation Cancer with Mars' RA=8^h50^m. Explain (perhaps using a diagram) why if Mars and a full-Moon are together in the sky, Mars must be near its closest approach to the Earth. Consider the below (re-touched) photocopy of your SC001 star map. On your answer sheet, redraw the maps' rectangle that represents part of the celestial sphere and clearly label the celestial equator and ecliptic. Sketch the path of Mars on your rectangle between now and 23-Apr-2010 when Mars will again have RA=8^h50^m. On 21-Apr-2010 the Moon and Mars will be in conjunction; what will be the phase of that Moon?