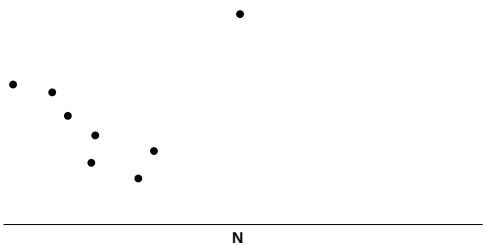
Answer *TRUE* or *FALSE* (<u>not</u> *T* or *F*) (2 pts each)

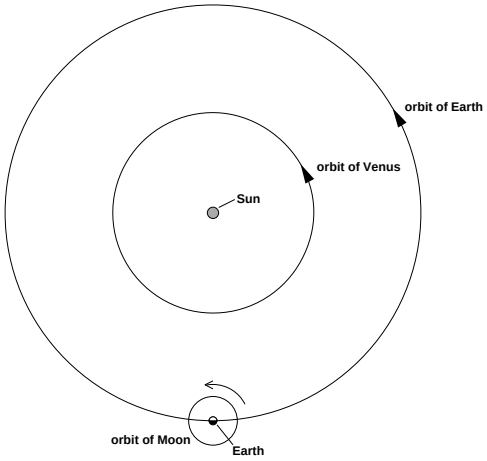
1. The smaller the magnitude, the brighter the star.
2. Latitude is to longitude as right ascension is to declination.
3. At CSB/SJU the celestial equator is an hour circle.
4. The meridian is part of a vertical circle.
5. The Sun is found on the celestial equator only at an equinox.
6. A planet in opposition to the Sun will be on the meridian at about midnight.
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. If in the morning the Sun is in the constellation Taurus, by the afternoon it would have moved on past the constellation Cancer.
10. Because of the motion of the Moon through the zodiac, each day, the Moon rises later.
11. Ptolemy lived and died before Christ.
12. At the time of a lunar eclipse the Moon enters the shadow of the Earth.
13. 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*.
14. 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".
15. The changing direction of the Earth's axis (the axis pointing in different directions during the year), is the primary cause of the seasons.
16. According to Newton, a constant force is needed to keep an object moving with a constant velocity.
17. If the radius of the Sun were to double (with the mass unchanged) there would be no change in the gravitational force of the Sun on the Earth.
18. A satellite orbiting the Earth in a circle at a constant speed is not accelerating.
19. 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.
20. 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)

21. In lab we said that the size of the lip of the bowl of the Big Dipper was about three fingers. Explain what this statement means. In lab we said that a fist was about twice the size of three fingers. How long would your left-side arm have to be if your left-hand fist equaled three fingers of your right hand?

22. The below right picture of the inner (Earth & 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 Christmass Venus will be in waning gibbous phase visible in the evening sky and the Moon will be in waxing crescent phase. Directly on the below diagram, write a "M" to denote the location of the Moon in the Solar System, and "V" to denote the location of Venus. Report a time of day and a direction (approximate azimuth, altitude) you should look to see the Moon on Christmas.





23. Consider the above left picture of a 9 P.M. view looking north at CSB/SJU. Directly on top of this picture, sketch what the view would look like 6 hours later. In a recent publication an SJU prof is quoted as saying: "When you are facing north, stars will appear to be moving from your right to your left. Their movement is slow but easily seen—". Is your answer consistent or inconsistent with this statement?

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

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

26. Report an example of (A) an inferior planet, (B) a superior planet, and (C) a celestial object the Greeks thought of as a planet, but we don't.

27. The Moon was in new phase a week ago (Friday 22-Sep-06). Clearly explain *when* and *where in the sky* you could see the Moon today. Estimate the date for the next full Moon.

28. Draw a picture showing the relative positions of the Sun, Moon and Earth during a solar eclipse.

29. 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 with a smaller eccentricity. Which or your orbits has the longer period?

30. On 29 September 2001 (five years ago) Saturn had R.A. = 4^h56^m and declination = $+21°$; Today 29 September 2006 Saturn has R.A. = 9^h35^m and declination = $+15°$. 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 5 years?

    (b) Round your answer to the previous question to a whole number of hours of RA. Given that Saturn has gone the above number of hours in five years, how many years would it take Saturn to go 24 hours of RA, i.e., all the way around the celestial sphere?

31. Sketch the rectangle that represents the celestial sphere on the SC001. (See question 40, if you forget what this looks like.) Draw the path of Saturn on this map over a five year period. Label the beginning of the path and a location where Saturn is moving retrograde. Recall that: "Superior planets have retrograde motion at opposition." How many times would Saturn be in opposition over five years?

32. Galileo noted that Venus shows the same set of phases as the Moon shows (i.e., crescent, half, gibbous, full, waxing/waning), and concluded (unlike the Moon) that Venus must go around the Sun. Explain how in this case similar data (same phases) lead to opposite conclusions (around Sun or Earth). Draw a picture showing the situation producing a new phase for Venus and the Moon. Draw a picture showing the situation producing a full phase for Venus and the Moon.

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

34. What is *centripetal acceleration*?

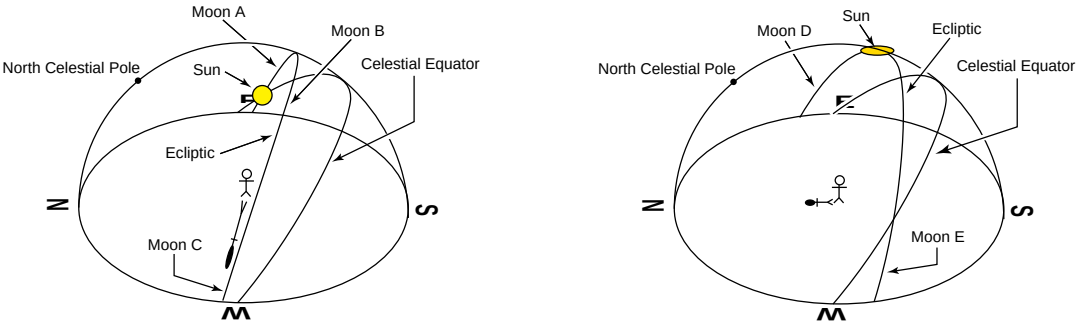
35. Going around in a tight circle in a car, you are forced to grab the car door handle to remain in your seat. Why? Draw a picture showing the situation as seen from high above the car. Show: direction of the turn, the direction of any horizontal forces acting on you, and the direction you would go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

Write out a complete answer (10 pts each)

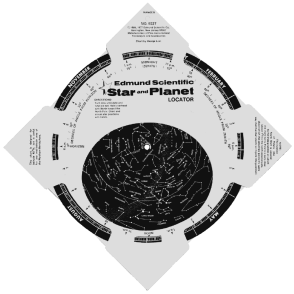
36. Tehran, Iran has a latitude of about 36°N and a longitude of about 51°E. On the coming winter solstice the planet Jupiter will have a right ascension of $16^h\,17^m$ and a declination of $-21°$. Report the time of day (on the winter solstice) when Jupiter crosses the meridian and its altitude at Tehran (you must report your reasoning to receive any credit). Is Jupiter visible as sunrise? sunset?

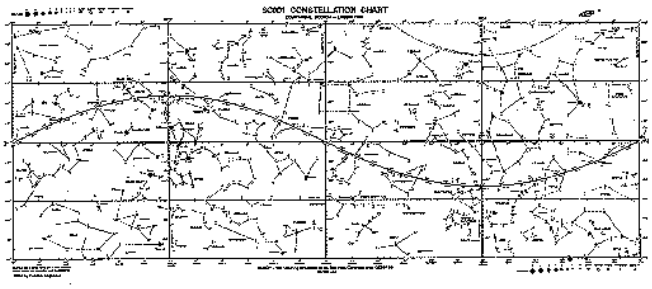
37. The space shuttle can "orbit" the Earth, i.e., not fall down, for a long time. How does that work? What exactly is needed? Astronauts in the space shuttle float, i.e., nothing seems to hold them down. How does that work?

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. Thus for each Moon position, you will want to draw a horizontal line representing the horizon and a shaped 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.



39. Consider the below (re-touched) photocopy of your Star Locator. Redraw the Star Locator's oval that represents the sky and clearly label where the following are found: horizon, meridian, zenith, north celestial pole, celestial equator, north, south, east, and west points on the horizon. Draw an arrow showing the direction the sky rotates over a day.





40. Consider the above (re-touched) photocopy of your SC001 star map. Redraw the maps' rectangle that represents part of the celestial sphere and 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 the Christmas location of the Sun, Moon, Venus, Jupiter, and Saturn. (Questions 22, 30, and 36 may be of use.)