

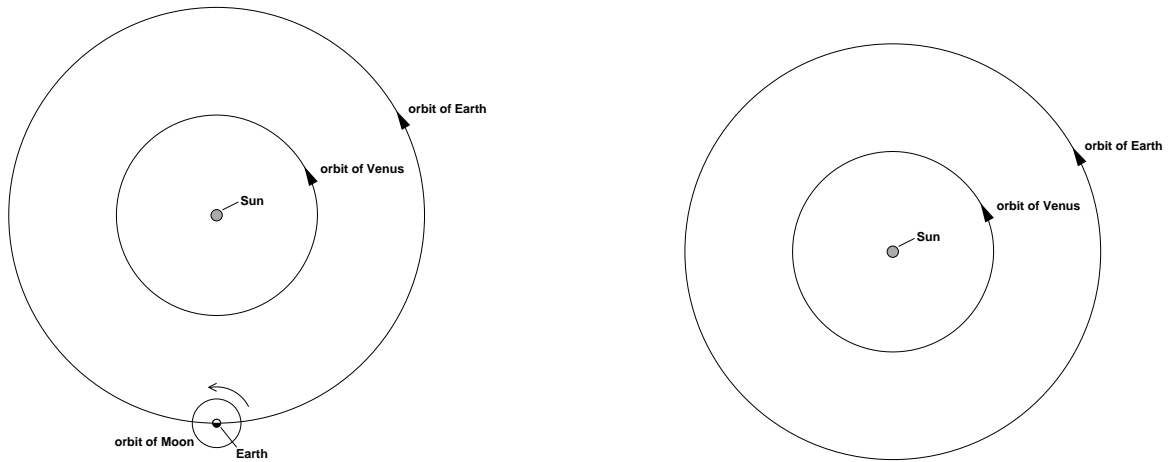
Answer *TRUE* or *FALSE* (not *T* or *F*) (2 pts each)

1. 1.5×10^7 is 15000000.
2. If SI units (the “metric system”) were being properly used a “micro phone” would be a thousand times smaller than a normal phone.
3. The smaller the magnitude, the brighter the star.
4. Right ascension is analogous to latitude; declination is analogous to longitude.
5. A diurnal circle is a great circle.
6. The meridian is part of a vertical circle.
7. The meridian is part of an hour circle.
8. The Sun is found on the celestial equator only at a solstice.
9. A planet in opposition to the Sun will be on the meridian at about midnight.
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. The far side of the Moon is continuously dark.
12. At the time of a lunar eclipse the Moon’s shadow hits 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. 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. Ptolemy lived and died before Christ.
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).

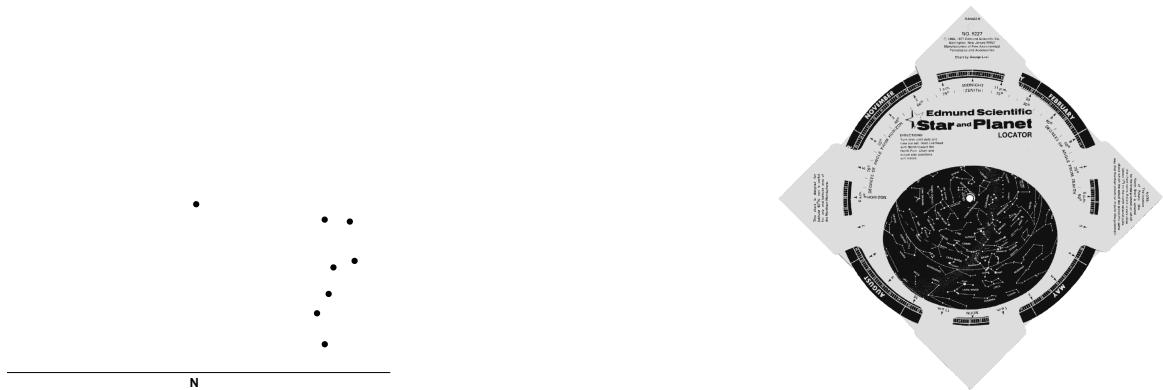
Give a short explanation (5 pts each)

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

22. Explain why the stars seen at night during the winter differ from those seen at night during the summer.
23. Both of the below pictures show the inner (Earth & in) Solar System as seen from a distant 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). Today Venus is just past maximum elongation visible in the morning sky and the Moon is first quarter phase. Directly on the below left diagram, write a "M" to denote the location of the Moon in the Solar System, and "V" to denote the location of Venus. Show/label the situation 2 sidereal months (54.6 days) later: Directly on the below right diagram write a "E" to denote the location of the Earth, "M" to denote the location of the Moon, and "V" to denote the location of Venus. What is then the phase of the Moon?



24. Consider the below 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.



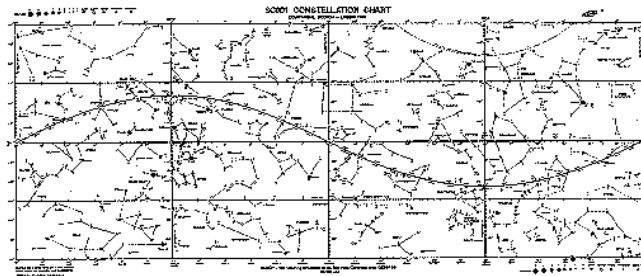
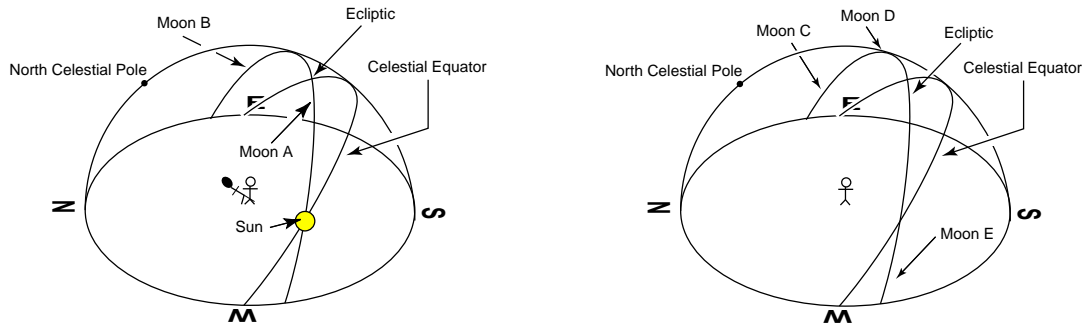
25. Consider the (re-touched) photocopy of your Star Locator shown above right. On your answer sheet redraw the Star Locator's oval that represents the sky and clearly label where the following are found: zenith, meridian, north celestial pole, celestial equator and west point on the horizon.
26. Describe the cause of our seasons. (I.e., why in Minnesota is it colder in December than it is in June?)
27. Draw a picture showing the relative positions of the Sun, Moon and Earth during a solar eclipse.

28. On 11 February 2006 (five years ago) Saturn had R.A. = 9^h37^m and declination = $+19^\circ$; Today 11 February 2011 Saturn has R.A. = 13^h06^m and declination = -4° . 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:
- Through how many hours of RA has Saturn moved during the last 5 years? (Round your answer to the nearest half hour of RA.)
 - Set up a proportion: Given that Saturn has gone the above number of hours in five years, how many years (x) would it take Saturn to go all the way around the celestial sphere? (If you have a calculator handy you may solve for the actual number of years; if not just leave an equation ($x = \text{stuff}$) showing the required calculation.)
29. Sketch the rectangle that represents the celestial sphere on the SC001. (See question 39, 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?
30. The Moon is in first quarter phase today (11 Feb 2011). Clearly explain *when* and *where in the sky* you could see the Moon today. The end of Spring Break is 5 weeks away. Clearly explain *when* and *where in the sky* you could see the Moon at the end of Spring Break.
31. Draw a picture of an orbit around the Sun with a large eccentricity. Label the position of Sun. Add to your solar system another orbit about the Sun with a smaller eccentricity. Clearly label this new orbit "small e ". Which of your orbits has the longer period?
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. Identify an important contribution of each of the following people: Kepler, Tycho, and Ptolemy.
34. State two of Newton's "four" laws of motion.
35. While making a tight left-hand turn in a car the books piled in the passenger seat next to you slide into the passenger door and are pegged there until you complete your turn. Why? Draw a picture showing the situation as seen from high above the car. Show: the path of the turn, the direction of any horizontal forces acting on the books, and the direction the books would go if there were no forces acting on them.

Write out a complete answer (10 pts each)

36. Cairo, Egypt has a latitude of about 30°N and a longitude of about 31°E . On 21-January-2011 the planet Mars had a right ascension of 20^h27^m and a declination of -20° . Report the time of day (on 21-January-2011) when Mars crossed the meridian and its altitude at Cairo (you must report your reasoning to receive any credit). Was Mars visible at 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 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 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; Moon position *C* is in the east, and *D* on the meridian, and *E* is in the west.



39. Consider the above (re-touched) photocopy of your SC001 star map. On your answer sheet, redraw the map’s 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 current location of the Sun, Moon, Venus, Mars, and Saturn. (FYI: Questions 30, 23, 36, and 28 may be of use.)
40. Most people would find the statement: “Chicago is 355 miles from Minneapolis” more useful than the statement: “Chicago is 5.1° from Minneapolis”, but they contain the same information. Explain the meaning of second statement. Draw a diagram showing Minneapolis and Chicago on a circle representing the Earth. Show on your diagram where the 355 miles could be measured and where the 5.1° could be measured.

Which of the following statements do you find more useful and *why*. (Your grade will depend entirely on your explanation of “why” as either might be more useful.) (A) “The star Dubhe is 328 Light Years from Polaris” or (B) “The star Dubhe is 28° from Polaris”. Draw a diagram showing Dubhe, Polaris and a dot representing the Earth. Show on your diagram where the 328 LY could be measured and where the 28° could be measured.

Explain how you could yourself directly confirm the accuracy of statement (B) (be specific).