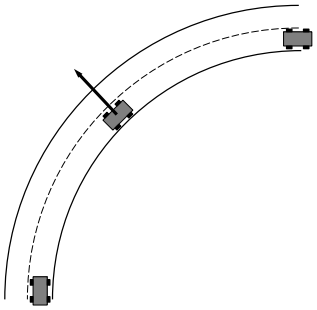
Except for questions 18, 19, 20, 21, 31, and 32 marks/answers on these sheets are not graded.

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

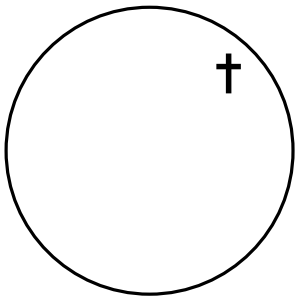
1. 1.5×10^{-1} is .015
2. If SI units (the "metric system") were being properly used a <u>milli</u>pede would be a thousand times smaller than a normal pede.
3. Diurnal circles are great circles.
4. Zenith on the Star Finder is the brass grommet that pins the rotating star map to the body of the Star Finder.
5. Here at CSB/SJU the altitude of Polaris is about 45°.
6. On the Earth's equator (latitude=0°) the Sun goes through zenith every day.
7. A star on the meridian tonight at 9 P.M. will be east of the meridian at 9 P.M. a month from today.
8. The larger the magnitude, the brighter the star.
9. 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.
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. On the winter solstice the right ascension of the Sun is 18^h and the declination is $-23\frac{1}{2}^\circ$.
12. The changing direction of the Earth's axis (the axis pointing in different directions during the year), is the primary cause of the seasons.
13. Copernicus was born before St. Benedict.
14. A satellite orbiting the Earth in a circle at a constant speed is not accelerating.
15. Since the Sun is more massive than the Earth, the gravitational force of the Sun on the earth is greater than the gravitational force of the Earth on the Sun.
16. According to Newton's mechanics, if you make a right hand turn at high speed (as shown right) there is an outward force on you as shown in the diagram.

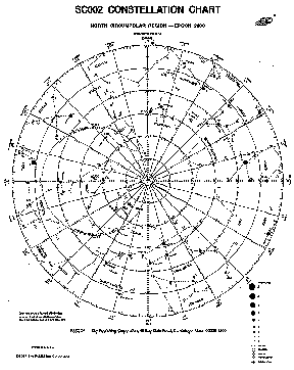


Give a short explanation (5 pts each)

17. A biology book says that a cell is a circle 10^{-5} m in diameter and that the cell's nucleus is 2×10^{-6} m in diameter. You draw a 2 inch diameter circle to represent the cell. What diameter circle should you use to represent the nucleus?

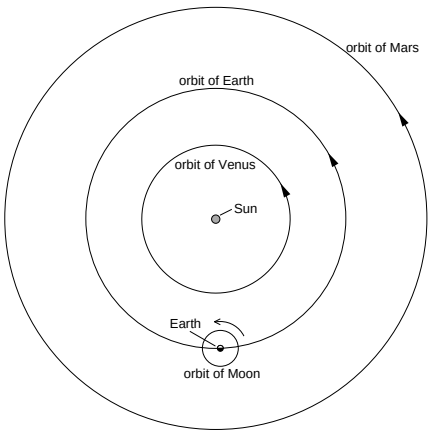
18. The below left is a (mostly empty) sky map. Directly on this sheet sketch and label: meridian, north celestial pole, due east horizon. Assume the cross is a star pattern in the sky. Draw on your answer sheet a horizontal line representing the horizon and place a cross above your line showing how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

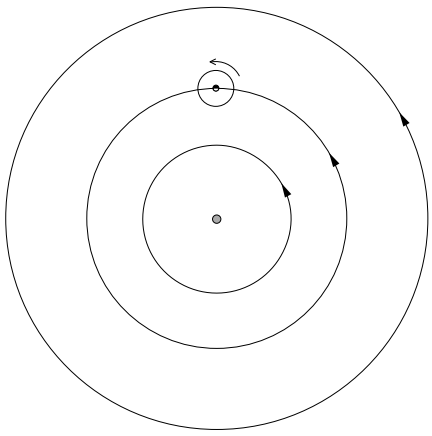




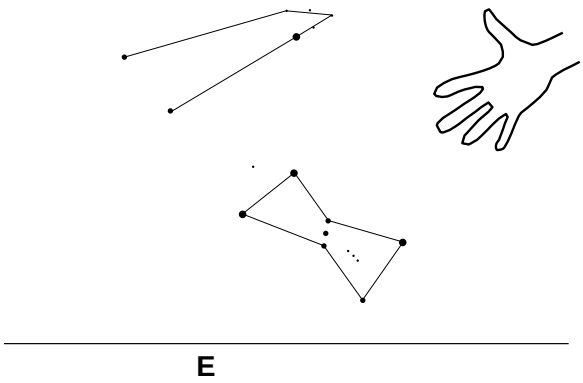
19. Consider the above right copy of your SC002 star map. Directly on this sheet clearly label: a diurnal circle, an hour circle and the north celestial pole. Draw an arrow showing how the map would rotate if it were matching the rotation of the celestial sphere.

20. The cartoons below show the inner (Mars & in) Solar System as seen from a point high above the Earth's north pole on 5-Oct-2017 (left) and Easter 2018 (right). The arrows show which way the planets go around the Sun (which is also the way the Earth spins). On October 5, the Moon will be full, Mars & Venus will be close together (less than a Moon apart) in the morning sky (a 'conjunction' of Mars & Venus). Next Easter (1-Apr-2018) Mars will nearing its time of retrograde motion (which will start 26-Jun-2018), Venus will be prominent in the evening sky, and the Moon will be waning gibbous. Directly on the below diagrams, map the Solar System as it will be on 5-Oct-2017 (left) and on 1-Apr-2018 (right, note that the Earth has moved over those 6 months). Mark "L" to denote the locations of the Moon, "V" to denote the locations of Venus, and "M" to denote the locations of Mars.





21. Consider the right cartoon of a midnight view looking east at CSB/SJU tonight. If the Celestial Equator were a visible line in the sky it would connect exactly to due east on the horizon. Directly on the diagram, draw how the CE would be oriented in the sky. Directly on top of this picture, sketch what the view would look like 1 hour later.



22. Describe the cause of the seasons on the Earth.

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

24. Draw a picture showing the relative positions of the Sun, Moon and Earth during a solar eclipse. Explain why solar and lunar eclipses often occur in the same month just a couple of weeks apart and what causes this 'eclipse season' to occur about 3 weeks earlier the following year.

25. The Moon will be full on Thursday October 5^{th}; Thanksgiving is 7 weeks later. Report the Moon's phase on Thanksgiving (23-Nov-2017). Clearly explain and report a time-of-day *when* and *where in the sky* (e.g., what very approximate azimuth or cardinal direction) you could see the Moon on Thanksgiving.

26. Define *equant*. What phenomena caused Ptolemy to use equants for the Sun's motion about the Earth?

27. What evidence did Galileo use to support the heliocentric model? 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. (Be specific.)

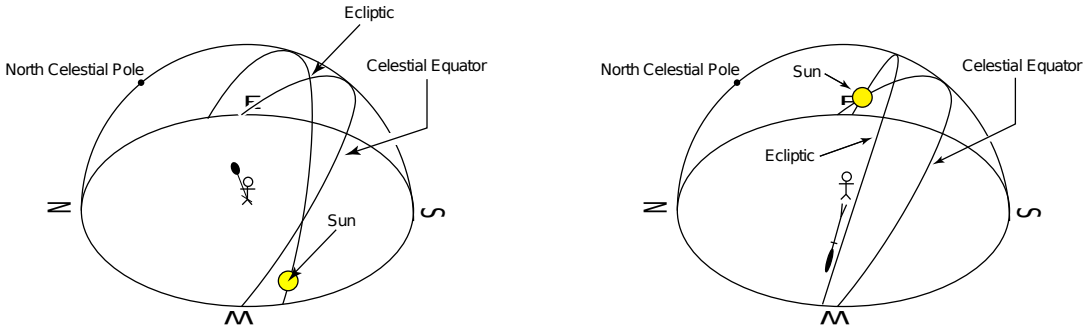
28. Draw a picture of an orbit around the Sun with a large eccentricity. Label the position of Sun. Add to your diagram (and clearly label "small") another orbit about your Sun with a smaller eccentricity. Which of your orbits has the longer period?

Write out a complete answer (10 pts each)

29. In the fall of 1572 Tycho Brahe observed a new star, brighter than Venus (a 'super nova'), in the constellation Cassiopeia at R.A.=0^h25^m and declination=64.2°. History records that Queen Elizabeth summoned the mathematician and astrologer Thomas Allen, "to have his advice about the new Star that appeared in the Cassiopeia." While history doesn't record this part, I'm sure she asked at what time of day should she look for the new star to culminate on 21-Nov-1572 and what altitude it would have at that time at Buckingham Palace, London (latitude 51.5°N, longitude 0.1°W). Calculate the answer to the Queen's question!

30. The space station 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 station float, i.e., nothing seems to hold them down. How does that work?

31. Consider the below diagrams of the dome of the sky. In the left diagram, the Sun is near the western horizon; in the right diagram the Sun is near the eastern horizon. Directly on the appropriate diagram, locate (with a label and an arrow pointing at the proper spot) where each of the following four Moons would be in the sky: (A) waning crescent, (B) waxing crescent, (C) waning gibbous, and (D) waxing gibbous. Draw what (A) and (B) would look like to the stick figure in the diagrams. (Remember to label which part of your drawn Moon you intend to be white and which part black.) Report the approximate date of each drawing.



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), location of the Sun on the our summer solstice, an hour circle and a diurnal circle. Finally display and label the location on 5-Oct-2017 of the Sun, Moon, Venus, and Mars. (Questions 20, and 25 may be of use.)