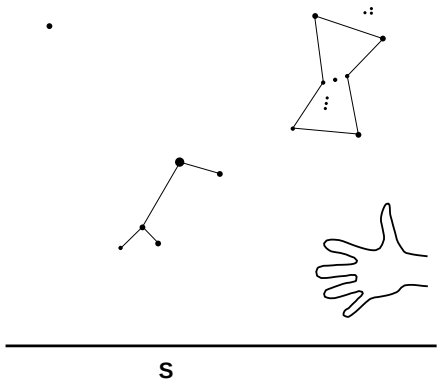
Except for questions 21–24, and 39 marks/answers on these sheets are not graded.

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

1. 1.5×10^{-3} is .00015
2. If SI units (the "metric system") were being properly used a <u>Mega</u> mall would be a billion times bigger than a normal mall.
3. On the Earth's equator (latitude=0°) the Sun will go through zenith on the equinox.
4. The declination of the star Kochab (in Ursa Minor) is about 74°, so using your 'handy protractor' it should take a bit less than a hand reach the star Polaris.
5. The right ascension of the Sun increases by about 1^h per hour of clock time.
6. The right ascension of the Sun increases by about 4^m per day of clock time.
7. Every vertical circle passes through the observer's zenith.
8. *Altitude* is the angle between a star and the celestial equator.
9. On the equinoxes the Sun is 90° from the celestial poles.
10. There are two eclipse seasons per year: when the Sun is near the line of nodes.
11. Kepler's areal law substituted for Ptolemy's equant.
12. Newton died before 1776.
13. Since Venus and Saturn both orbit the Sun, from Earth they both display all possible phases from new to full.
14. 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.
15. Newton's second law states that the speed of an object is proportional to the force and inversely proportional to its mass.
16. The force of gravity on an astronaut orbiting in the Space Shuttle is much less than it is on the surface of the Earth.
17. The far side of the Moon is continuously dark.
18. The changing direction of the Earth's axis (the axis pointing in different directions during the year), is the primary cause of the seasons.
19. According to Newton, a constant force is needed to keep an object moving with a constant velocity.
20. A satellite orbiting the Earth in a circle at a constant speed is not accelerating.

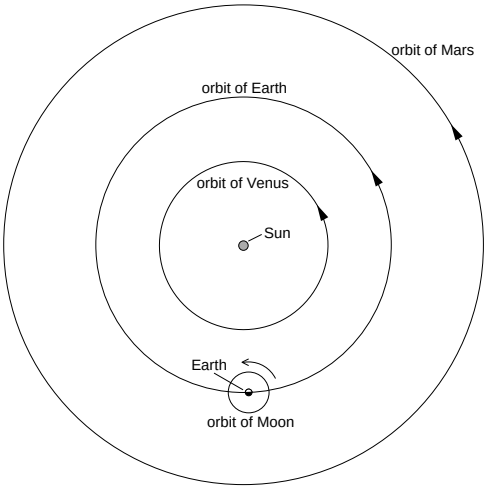
Give a short explanation (5 pts each)

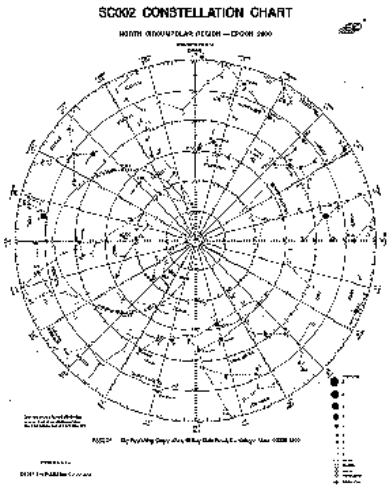
21. The below left is a strangely oriented sky map for February nights. Directly on top of this diagram find and label the location of the north celestial pole using the "pointers" of the Big Dipper. Label the cardinal directions: north, east, and zenith. I have circled the constellation Cepheus. On your answer sheet draw a horizontal line representing the horizon, and place Cepheus above your horizon oriented as it would appear in the sky.



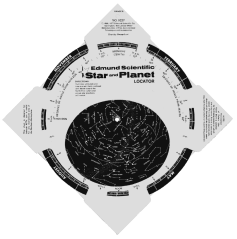
22. Consider the above right picture of a 10 P.M. view looking south at CSB/SJU. Directly on top of this picture, sketch what the view would look like 1 hour later.

23. The diagram below left shows the orbits of Venus, Earth, Mars and the Moon (not to scale). Tonight Venus is an evening star that if viewed in a telescope would show nearly a half illuminated disk. Mars is about a month from opposition. There was a full moon 3 days ago. Directly on the diagram, write "**L**" at the location of the Moon in the Solar System, "**V**" at the location of Venus, and "**M**" at the location of Mars.





24. 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 arrowing showing how the map would rotate if it were matching the rotation of the celestial sphere.



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

26. On 10 Feb 2007 (five years ago) Saturn had R.A. = 9^h37^m and declination = $+16°$; Today 10 Feb 2012 Saturn has R.A. = 13^h53^m and declination = $-9°$. 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?

27. Why do we see different stars December evenings than we do June evenings?

28. Good Friday is 8 weeks from today and according to question 23 there was a full moon 3 days ago. What phase of Moon should you expect to see on Easter? At sunrise on Easter, will the Moon be above the horizon? If so report its location (very approximate altitude/azimuth) in the sky.

29. Draw a picture showing the positions of Sun, Earth, and Moon during a lunar eclipse. Explain why you are much more likely to see a lunar eclipse than a solar eclipse.

30. Key West FL has a latitude of about $24\frac{1}{2}^\circ$. Does the Sun ever go through zenith at Key West? If so: on what date? If not: on what date does it come closest to zenith and how close does it come to zenith (in degrees)? On that same date how far is the Sun from zenith at CSB/SJU?

31. Describe the cause of our seasons. (I.e., why in Minnesota is it colder in December than it is in June?)

32. "Superior planets have retrograde motion at opposition." Define: superior planet, retrograde motion and opposition.

33. Identify an important contribution of each of the following people: Copernicus, Tycho, and Ptolemy.

34. State two of Newton's laws of motion.

35. State two of Galileo's observations that supported the heliocentric theory of the Solar System.

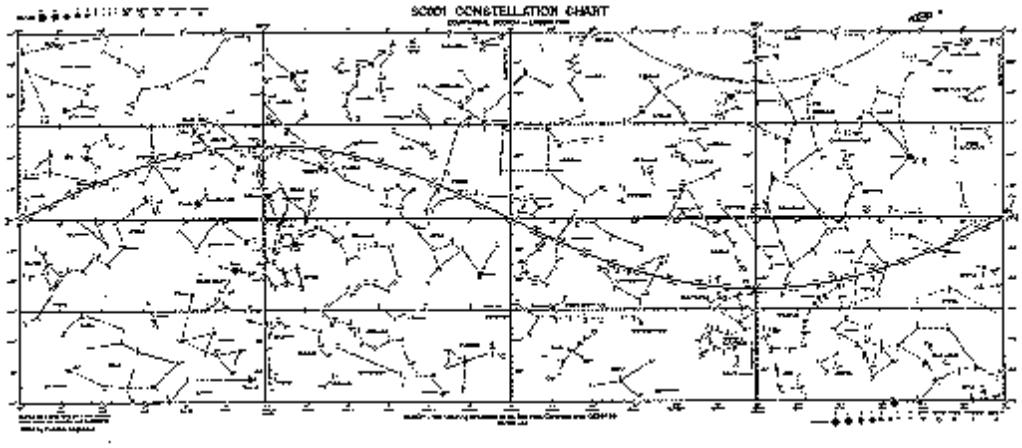
Write out a complete answer (10 pts each)

36. Damascus, Syria has a latitude of about 34°N and a longitude of about 36°E. On February 21 the planet Jupiter will have a right ascension of 2^h14^m and a declination of 12°. Report the time of day (on February 21) when Jupiter crosses the meridian and its maximum altitude on that day at Damascus (you must report your reasoning to receive any credit).

37. (a) Draw an ellipse and display on your drawing the location of the Sun and a semi-major axis. Label on your ellipse the spot where the planet would be moving its fastest and where the planet would be moving slowest. State Kepler's second law (that has to do with varying speeds in an orbit).

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

38. 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?



39. Consider the above photocopy of your SC001 star map. Redraw on your answer sheet the map's rectangle and clearly label where the following are found: celestial equator, ecliptic, an hour circle and a diurnal circle. Using the data in questions 23, 26, and 35, label directly on the above SC001 the location of the Sun, Venus, Mars, Moon, Saturn, Jupiter today.

40. 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 name the Moon (waning/waxing, crescent/gibbous, etc) and draw what the Moon would look like to the stick figure (i.e., a person on Earth). Thus for each Moon position, 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. Report the approximate date of both diagrams.