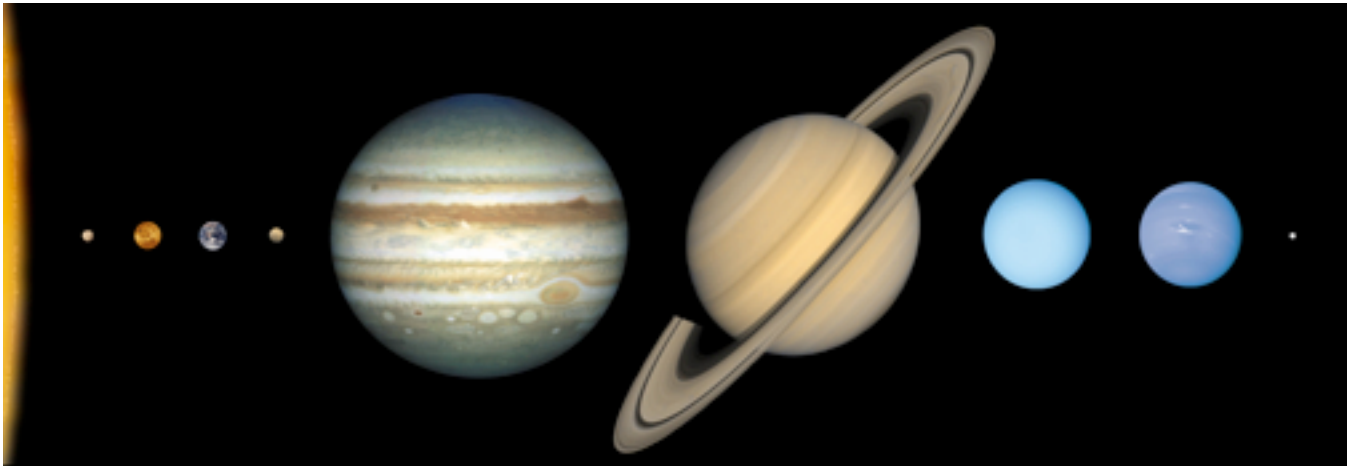


**Nevada State Science Olympiad
Solar System Division Event
6 March 2010
Rancho High School
Las Vegas, Nevada**



TEAM/SCHOOL NAME: _____

TEAM MEMBERS: _____

INSTRUCTIONS:

1. Attempt to answer all questions. There is no additional penalty for wrong answers.
2. Please turn in ALL MATERIALS at the end of this event.
3. Do not forget to put your TEAM NAME and TEAM NUMBER at the top of all Answer Pages.
4. Good Luck!

Note: This Exam and answer key will be published on the Las Vegas Astronomical Society website at <http://www.lvastronomy.com>. Harold Nations, Phd., Professor of Astronomy at the College of Southern Nevada, assisted the LVAS in preparation of this exam.

1. The Moon always shows the same face or surface area to inhabitants of the Earth. This is a result of Tidal Lock.

2. Our Sun will most likely end its life as a White Dwarf.

3. Label the 6 major layers of our Sun:

1. A - Corona

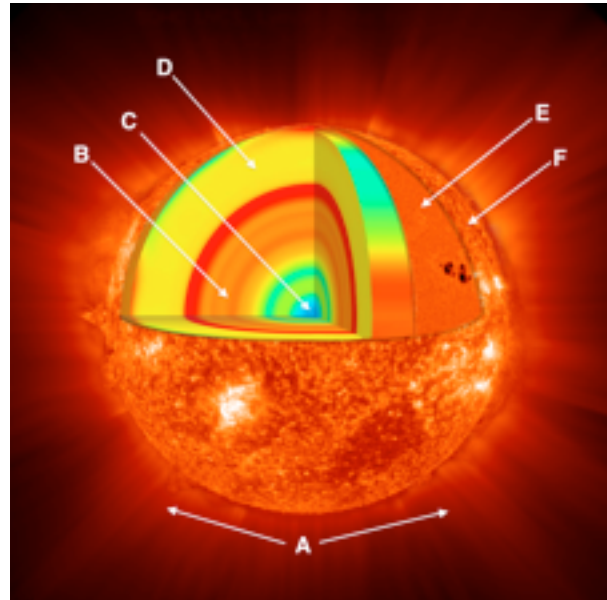
2. B - Radiative/Radiation Zone

3. C - Core

4. D - Convective/Convection Zone

5. E - Photosphere

6. F - Chromosphere



4. If the last peak in sunspot numbers occurred in 2002, the next solar max should occur in 2013.

5. All planets orbit the Sun in the Ecliptic plane.

6. Which spacecraft entered into orbit around Saturn in 2004? Cassini.

7. Pluto was discovered by Clyde Tombaugh in the year 1930 at Lowell Observatory in Flagstaff, AZ.

8. Almost all of our atmospheric gases lie in the layer of our atmosphere known as the Troposphere.

9. Our Sun is about half-way through its life cycle and is thought to be about 4 to 5 billion years old.

10. If an Earth rock contains 15 million atoms of Lead₂₀₇ and 1 million atoms of Uranium₂₃₅, then that rock must be four half-lives old. If the half-life of U₂₃₅ is 700 million years, that rock is 2.8 billion years old.

The total number of atoms equals 16million. 1 half-life would leave 8 million; 2 half-lives would leave 4million; 3 half-lives would leave 2million; and 4 half-lives would leave 1million atoms; therefore 4 half-lives have passed. If one half-life of U₂₃₅ is 700 million years, the answer is 4 x 700 million equals 2.8 billion years.

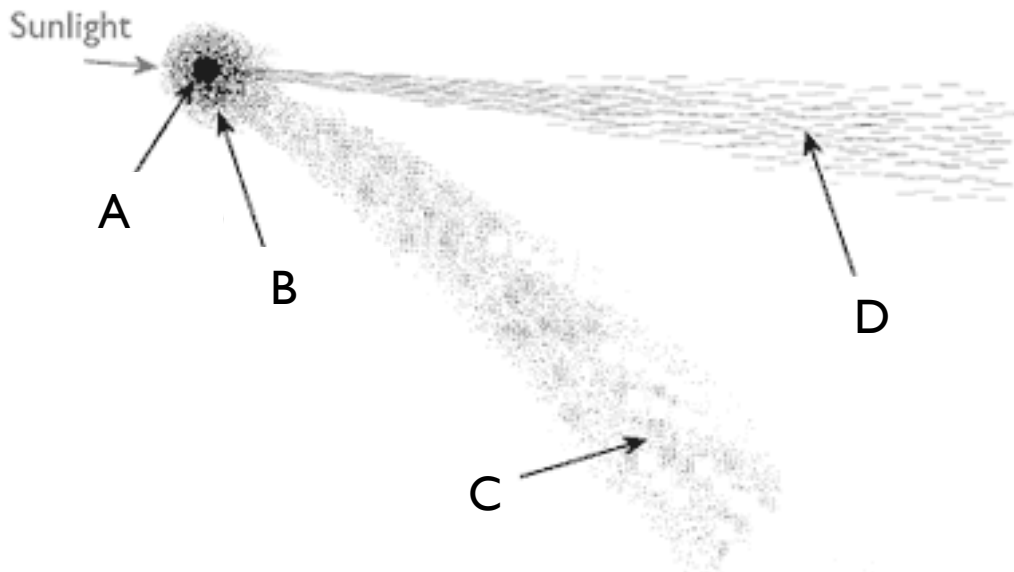
11. The Mid-Atlantic Ridge/Rift is the largest tectonic feature on our planet.
12. When strong solar wind storms are diverted poleward by our magnetic fields, we often observe Aurora in the ionosphere.
13. The largest volcano in the solar system, named Olympus Mons is located on Mars.
14. Mercury has the widest range of surface temperatures of any planet.
15. The Moon has a period of rotation that is equal to its period of revolution.
16. Venus and Uranus rotate in a clockwise or retrograde direction (as seen from above the solar system) rather than the counter-clockwise rotation of the other planets.
17. The Earth owes its seasons to its axial tilt of 23.5 degrees.
18. Venus' atmosphere is about 95% carbon-dioxide.
19. The Sun's position in the sky at noon on the Vernal Equinox plays the same role as Greenwich, England on the Earth for locating the "Prime Meridian" on the sky.
20. What three conditions must be met for a total solar eclipse to occur?
- 20.1. Moon must be at or near perigee

20.2. Moon must be at New Moon Phase

20.3. Moon must be near a node in its orbit near the ecliptic

21. The four Jovian moons visible from Earth were first discovered by Galileo 401 years ago.
22. The largest satellite in the solar system is Ganymede.
23. The two principal components of Jupiter's atmosphere are Hydrogen and Helium.
24. The rotational axis of Uranus has a 98 degree inclination to its orbit about the Sun.
25. Neptune's moon Triton is the only large moon known to have a retrograde orbit.
26. Identify the classes of asteroids described below:
1. Apollo asteroids have orbits that cross the orbit of Earth at perihelion, but on average, lie farther out than the earth. They pose the greatest danger for impacts.
 2. Aten class asteroids have periods of less than a year.
 3. An Amor asteroid has a perihelion that is safely outside Earth's orbit.
 4. Trojan asteroids have orbits greater than 3 AU from the Sun and share the orbit of Jupiter.
27. The Asteroid Belt is believed to be debris left over from the age of formation of the solar system; the tidal effects of Jupiter or Jupiter's gravity probably prevented formation of a major planet there.
28. Most long period comets are thought to originate in a huge spherical region at the outer edge of the solar system called the Oort Cloud, containing perhaps a trillion comets.

29. Identify the parts of a comet on the diagram below.



A: Nucleus B: Coma C: Dust Tail D: Ion Tail

30. The bluish gas or ion tail of a comet is pushed radially outward by the effect of the Solar Wind.

31. Describe why meteor showers occur - include the period of their occurrence in your explanation.

Answer: The Earth passes through a Comet's dust tail - as the dust particles enter the Earth's atmosphere friction causes them to heat up and burn. Periodic showers like the Orionids, Perseids, Leonids, etc. occur on almost the same day/date each year as the Earth passes back through a particular comet's tail. The showers get their names from the constellation where the radiant or point of origin for the meteors appears to be.

32. The recent extended period of minimum sun spot activity had scientists wondering if we might be experiencing the beginning of another minimum similar to the Maunder Minimum that occurred between 1645 and 1715.

33. Solar energy production is mainly due to the proton-proton cycle of thermonuclear reactions as Hydrogen is fused into Helium.

34. A Solar Eclipse can only occur during a lunar conjunction, also known as a New Moon. Describe the relationship between the Earth, Moon, and Sun during a Solar Eclipse.

A Solar Eclipse occurs when a New Moon passes directly between the Earth and the Sun. The angular size of the Moon and Sun are almost equal especially when the Moon is at perigee (closest to the Earth), thus the Moon blocks out the light from the Sun.

35. A Lunar Eclipse can only occur during a lunar opposition, also known as a Full Moon. Describe the relationship between the Earth, Moon, and Sun during a Lunar Eclipse.

The Earth passes directly between the Sun and the Moon during a Full Moon. The Earth blocks the Sun's rays from striking the Moon. Unlike a Solar Eclipse where there is only a limited track of the Moon's shadow on the Earth, a Lunar Eclipse can be seen anywhere on the Earth where the Full Moon would normally be seen on the night side of the Earth. A Lunar Eclipse last for several hours while a Solar Eclipse lasts for only minutes.

36. More important than magnification is a telescope's ability to gather light, which determines how bright an object is and its resolving power, which allows the observer to see more detail.

Note: Show work for Questions 37 thru 40 on last page.

37. The Moon lies roughly 384,000 km from the Earth and the Sun lies 150,000,000 km away. If both have the same angular size as seen from the Earth, how many times larger than the Moon is the Sun? a: 390 a: 390; b. 3,900; c: 3.9; d: 390,000

Simply divide the distance to the Sun by the distance to the Moon to get 390 times.

38. Given that the distance from the Earth to the Sun is 150,000,000 km, what distance does the Earth travel in:

1. 1 second 30km (to the nearest 10km)
2. 1 minute 1,800km (to the nearest 10km)
3. 1 hour 108,000km (to the nearest 1,000km)
4. 1 day 2,600,000km (to the nearest 100,000km)

If you know that Earth has a velocity of approximately 30km/s around its orbit you can use that fact to compute the values for 1 min, 1 hour, and 1 day. Without that fact, you have to compute the circumference of Earth's orbit based on a radius of 150,000,000km that was given to you in the problem. Using the formula for determining circumference ($2 \times \pi \times r$) you get $2 \times 3.14159 \times 150,000,000 = 942,477,796\text{km}$ for Earth's orbital circumference. To determine the approximate distance traveled in a day, divide the circumference by 365; for 1 hour, divide by 365 then by 24; for 1 minute, divide by 365 then by 24 then by 60; for 1 second divide by 60 one more time.

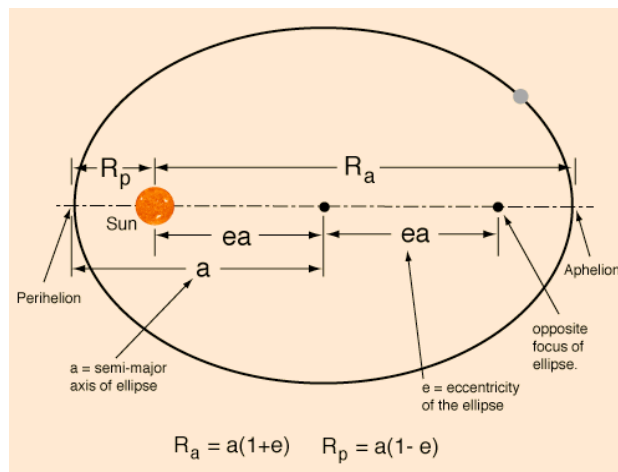
39. A 2-meter telescope collects four times more light than a 1-meter scope?

You could compute the area of each telescope mirror using the formula for the area of a circle is πR^2 , but that is not necessary for what the question asked. The amount of light a telescope gathers is proportional to the square of the radius of the scope's mirror, thus $1^2 = 1$ and $.5^2 = .25$; 1 divided by $.25 = 4$; therefore, a 2-m scope collects 4 times more light than a 1-m scope.

40. Given the following information, estimate the minimum possible distance between Mars and Earth to the nearest 100,000 km. (Hint: Which planet is at aphelion and which is at perihelion?) Answer: 51,750,000km

Given: 1 AU equals 150,000,000 km

Planet	Orbital Semimajor Axis	Orbital Eccentricity
Earth	1 AU	0.02
Mars	1.5 AU	0.09



The closest distance between Earth and Mars occurs when Mars is at opposition (Mars is on the opposite side of the Earth from the Sun), Earth is at aphelion (farthest distance from the Sun in its orbit) and Mars is at perihelion (closest to the Sun in its orbit). If 1 AU equals 150,000,000: then Earth at apogee has a semi-major axis of $150,000,000 \times (1+.02) = 153,000,000\text{km}$. Mars at perigee has a semi-major axis of $225,000,000 \times (1-.09) = 204,750,000\text{km}$.

$204,750,000 - 153,000,000 = 51,750,000\text{km}$ is the minimum possible distance that can separate Mars and Earth.