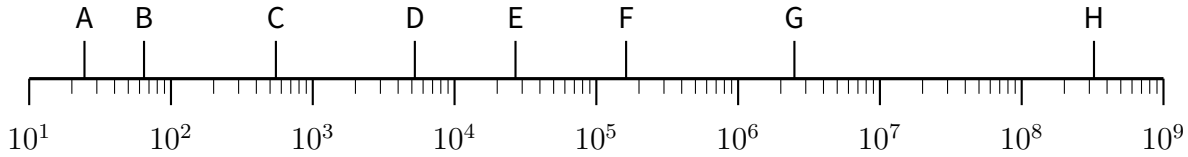
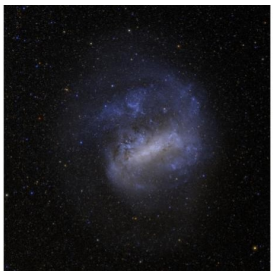
International Astronomy and Astrophysics Competition
Qualification Round 2026

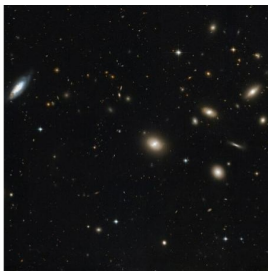
Problem A : Cosmic Distances (5 Points)

Astronomy explores a universe that spans an extraordinary range of distances. Below are astronomical images and a logarithmic distance ruler showing distance from Earth in light-years. Each image matches one object name and one labeled position (A–H) on the ruler: *Coma Cluster, Aldebaran, Eagle Nebula, Large Magellanic Cloud, Pleiades, Andromeda Galaxy, Sagittarius A*, Vega*.

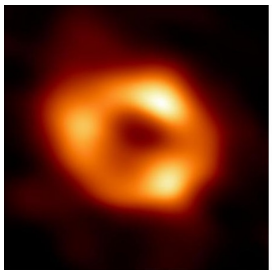


For each image, find the matching name and position on the distance ruler (A-H):





1. *Pleiades (C)* 2. _____ 3. _____ 4. _____



5. _____ 6. _____ 7. _____ 8. _____

Problem B : Low Earth Orbit (5 Points)

Earth is surrounded by an increasing number of human-made satellites. At present, approximately 13,500 satellites orbit our planet in low Earth orbit (LEO), the region of space extending from about 160 km to 2,000 km above Earth's surface.

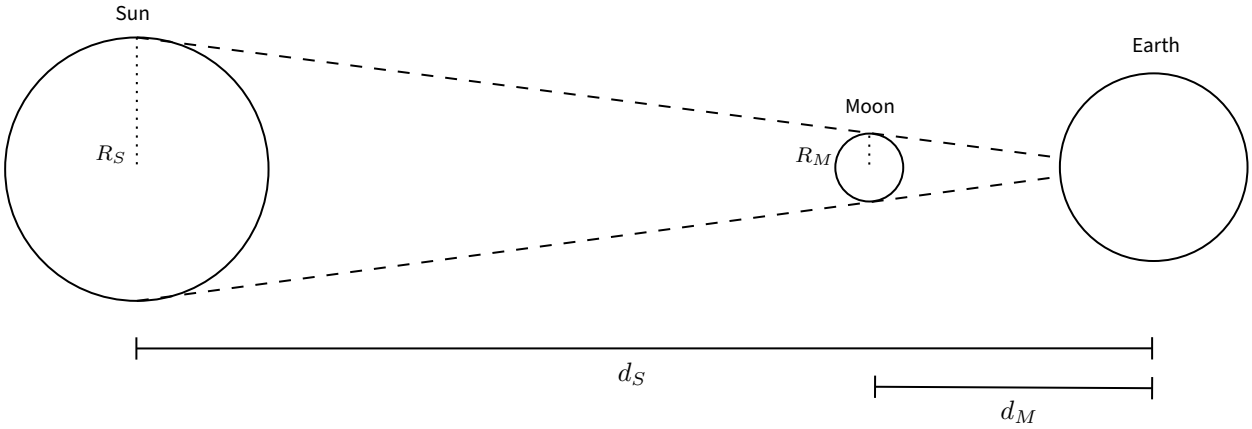
(a) Calculate the total volume of space contained within low Earth orbit (in km^3).
Note: The radius of the Earth is around 6,370 km.

(b) Determine the average volume of space available to each satellite.

Problem C : Total Solar Eclipse (5 Points)

Solar eclipses are among the most fascinating phenomena observable from Earth. They occur when the Moon passes between Earth and the Sun, temporarily blocking the Sun's light. Although the Sun is much larger than the Moon, both objects can appear nearly the same size in the sky because of their different distances from Earth.

(a) What is the difference between *total*, *partial*, and *annular* solar eclipse?
(b) The Qualification Round deadline is in April 2026. When will the next total solar eclipse occur?



(c) Let R_M and R_S be the radii of the Moon and the Sun, and let d_M and d_S be the Earth-Moon and Earth-Sun distances. Show that a total solar eclipse is only possible if

$$\frac{R_M}{d_M} \geq \frac{R_S}{d_S}.$$

Note: Explain the approximations used to get this simplified condition.

Problem D : The Last Eclipse (5 Points)

Total solar eclipses are possible today because the apparent sizes of the Sun and the Moon in Earth's sky are comparable. But, due to tidal interactions, the Moon is moving away from Earth by 3.8 cm per year. At the same time, stellar evolution causes the Sun's radius to increase gradually as it ages. According to Gough (1981), this increase can be approximated by

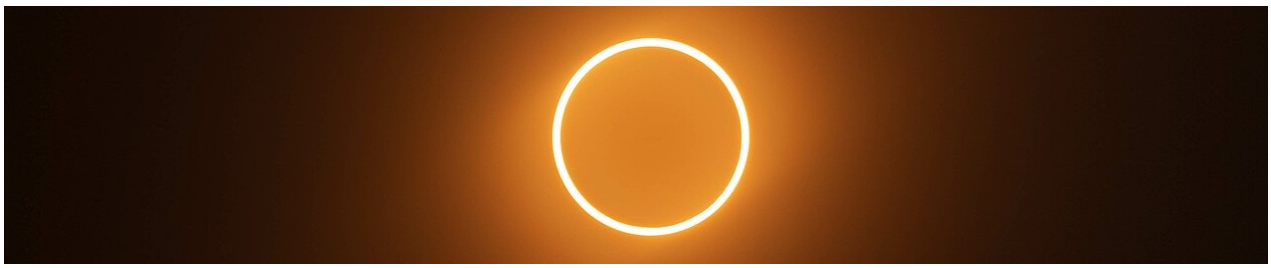
$$\frac{R_S(t)}{R_S(0)} = \sqrt{\frac{1}{1 - \frac{2}{5} \cdot \frac{t}{t_0}}},$$

where $R_S(t)$ is the Sun's radius at time t from today, and t_0 is equal to 4.6 billion years. Determine when, relative to today, the last total solar eclipse will take place.

Note: Use 1,740 km and 696,000 km for the Moon's and the Sun's radius; 356,000 km for today's Earth-Moon perigee distance; and 152,000,000 km for the constant Earth-Sun aphelion distance.

Problem E : Testing the Theory of Relativity (5 Points)

On 29 May 1919, a total solar eclipse provided astronomers with a unique opportunity to test Einstein's theory of relativity, which proposed a new understanding of gravity. Teams of scientists traveled to remote locations across the world to carry out challenging observations under difficult conditions, and the results quickly attracted worldwide attention.



Explain how the 1919 eclipse was used to test Einstein's theory of relativity.

Submission Information

You can write the solutions by hand or type it on a computer. Please show your work! To qualify for the Pre-Final Round, you have to score at least 15/17/20 points as a Junior/Youth/Senior participant. You need to submit your solution online by *Friday, 17 April 2026, 23:59 UTC+0* at www.iaac.space/submission. If you have questions or comments, feel free to reach out to us via e-mail at any time: info@iaac.space. Good luck!