**For the first 3 questions, use the data provided in question 1.**

1. Constellations can be found everywhere in the night sky! One of the most well-known constellations is the Big Dipper, which is made up of the seven stars Alkaid, Mizar, Aloith, Megrez, Phecda, Merak, and Dubhe. Their distances from Earth are 104, 86, 83, 81, 83, 80, and 123 light years away, respectively. Which star is the farthest away from Earth?

a) Mizar b) Megrez c) Dubhe d) Alkaid e) NOTA

2. What is the average distance of the seven stars from Earth in light years (rounded to the nearest thousandth)?

a) 92.142 b) 91.428 c) 92.1429 d) 91.429 e) NOTA

3. What is the mode of the distances from the seven stars to the Earth in light years?

a) 81 b) 123 c) 104 d) 83 e) NOTA

4. The Chiles Mu Alpha Theta is doing a fundraiser where they sell five-point star-shaped pasta! Assume that every pasta has the exact same dimensions, where each side is 5 cm long. What is the perimeter of one star pasta? (All answers are given in mm.)

a) 50 b) 30 c) 45 d) 60 e) NOTA

5. You can make your own constellation in the sky too! If there are 5 stars in the first row, 4 stars in the second row, and 8 stars in the third row, how many different constellations can you make if you have to select 1 star in the first row, 2 stars in the second row, and 4 stars in the third row (order does not matter)?

a) 19200 b) 8 c) 1200 d) 2100 e) NOTA

6. Aaron, Shaoyang, and Lebron James decide to visit a planetarium to get a good look at Orion’s belt. The fee to get in is $10 per person but the cashier says that they will let them in for free if they get this math question correct. Which of the following values of x satisfies both inequalities?

|4x-2| > 5

8x + 6 > -10

a) -1 b) 0 c) 0.5 d) 1 e) NOTA

7. Three stars in the sky form a right triangle. The legs of the triangle are 9 light years and 40 light years long. What is the hypotenuse of this triangle in light years?

A) 45 b) 40.5 c) 48 d) 41 e) NOTA

8. The 12 zodiac signs are named after the constellations in the sky. Each person has only one zodiac sign determined based on the day they were born. Katharine, Farhana, and Linsey do not know their zodiac signs. How many different zodiac sign combinations among the three of them are possible if order does matter and each person's sign is independent of each other?

a) 1728 b) 1080 c) 720 d) 36 e) NOTA

9. The brightest star in the sky, Sirius, is part of the constellation Canis Major and has a diameter of 12,000 km. What is the volume of the star, assuming that it is a perfect sphere? (The volume of a sphere can be found using the formula V=(4/3)𝜋r3.)

a) 1.728 x 1012 𝜋 km3 b) 2.304 x 1012𝜋 km3 c) 2.88 x 1011𝜋 km3

D) 2.16 x 1011 𝜋 km3 e) NOTA

10. The probability that we see the constellation, Canis Major, on a given night is 2/5. If we look at the night sky for 1000 consecutive nights, what is the expected number of times that we see the constellation?

A) 500 b) 400 c) 300 d) 200 e) NOTA

11. The ratio of the radii of two stars is 3:5. What is the ratio of their surface areas? Assume that the two stars are perfect spheres. (The formula for the surface area of a sphere is 4𝜋r2.)

A) 3:5 b) 25:9 c) 9:25 d) 5:3 e) NOTA

**For questions 12-15, use the information provided below.**

In a new hit mobile game called Constellation Conquesters, you start with one grain of rice. Over time, you can convert that grain of rice into other resources in order to eventually build a constellation. The more resources and constellations one has, the stronger they are. 1000 grains of rice is equal to one house, 75 houses is equal to one planet, and 30 planets is equal to one star. It takes 20 minutes to make 3000 grains of rice.

12. How many houses does it take to make a constellation consisting of 5 stars?

a) 2,250,000 b) 2,250 c) 150 d) 11,250 e) NOTA

13. How long does it take to make that same constellation consisting of 5 stars in **days** (round up to the nearest whole day)?

a) 52 b) 53 c) 54 d) 55 e) NOTA

14. The game has a new update where you get a lucky draw every day that you log in! You can either get a grain of rice or a star from the draw. The probability of getting a grain of rice from one draw is 98%. What is the probability of getting a star from one draw?

a) 0% b) 2% c) 5%

d) Cannot be determined from the information provided e) NOTA

15. The constellation Cassiopeia consists of 5 stars. Connecting 4 of the stars to make 2 lines and putting them in the Cartesian plane, we get the equations 4x + 5y = 21 and 5x – 10y = -3. What is the abscissa of their point of intersection?

a) 2 b) 3 c) 9/5 d) 8/5 e) NOTA

16. From my limited knowledge of constellations, I can only name 12 constellations in the sky. However, with your extensive knowledge of constellations, you can name 24 of them. What is the percent increase from the number of constellations I see, to the number that you see?

a) 100% b) 50% c) 200% d) 12% e) NOTA

17. If Cyrus can name 10 constellations, and Nicholas can name 8 constellations, what is the positive difference between the greatest number of distinct constellations that they can name together and the smallest number of distinct constellations they can name together?

A) 18 b) 2 c) 24 d) 16 e) NOTA

18. The most notable grouping of stars visible from Earth is the Big Dipper, which is part of the constellation Ursa Major. Part of the Big Dipper, the “bowl” portion, resembles a trapezoid. What is the area of a trapezoid with bases of 8 and 10 inches, and a height of 6 inches?

A. 24 sq. in. B. 54 sq. in. C. 64 sq. in. D. 70 sq. in. E. NOTA

19. In astrology, each of the 12 zodiac signs is attached to a specific constellation. If you were to guess the signs of two of your friends, given that they do not have the same sign, what is the probability that you guess both of them correctly?

A. B. C. D. E. NOTA

20. There are 88 officially recognized constellations. What is the 3rd smallest positive integer factor of 88?

A. 4 B. 8 C. 11 D. 22 E. NOTA

21. Some constellations are only visible from certain places. James is at a spot represented by the point (2,5) looking at a constellation, while Nelson is at the point (-1, 1) looking at a different constellation. If Nelson wants to travel to James to see the other constellation, what is the length of the shortest path he can take?

A. 2 units B. 3 units C. 4 units D. 5 units E. NOTA

22. Jiayi decides to drive to the top of a local hill to look at the night sky. It is a 5 mile drive, and Jiayi drives at 30 miles per hour the entire way uphill. He goes back down the hill the same way but drives at 2/3rds of his speed on the way up because he gets stuck behind someone who is looking at the stars while driving. (Don’t drive distracted kids!) How long does Jiayi drive during his entire trip?

A. 5 minutes B. 10 minutes C. 20 minutes D. 30 minutes E. NOTA

23. The northern circumpolar constellations are only seen from the Northern Hemisphere and a small portion of the Southern Hemisphere. Latitude is measured from 90 degrees north of the equator all the way down to 90 degrees south of the equator. Under optimal conditions, the northern circumpolar constellations can be seen from 90 degrees north to 25 degrees south. What fraction of the planet can see the northern circumpolar constellations during the night given optimal conditions?

A. B. C. D. E. NOTA

24. One of the most recognizable constellations in the sky is Orion, named after a hunter in Greek mythology. How many unique ways can you rearrange the the letters of the word “ORION”?

A. 5 B. 25 C. 60 D. 120 E. NOTA

25. In unofficial astronomical terminology, a cluster is composed of 18 groups, and a group is made up of 23 stars. How many stars are in 8 clusters?

A. 3,312 B. 414 C. 184 D. 144 E. NOTA

26. 30 of the 88 official constellations can be seen in the Northern Hemisphere. What is expressed in decimal form, rounded to the nearest hundredth?

A. 0.25 B. 0.34 C. 0.41 D. 2.93 E. NOTA

27. The smallest constellation in the sky is Crux, which only takes up about 0.17 percent of the night sky. What is 0.17 percent expressed as a decimal?

A. 1.7 B. 0.17 C. 0.017 D. 0.0017 E. NOTA

28. 47 of the 88 currently recognized constellations were named by Ptolemy in his book the *Almagest,* which was written about 1,870 years ago. If the rest of the 41 constellations were named at a constant rate afterwards, a new constellation would be named approximately how often? Round your answer to the nearest whole number.

A. Every 40 years B. Every 45 years C. Every 46 years D. Every 50 years E. NOTA

29. Yimo thinks he’s found a new constellation! He says the shape of the constellation is a quadrilateral with diagonals of equal length. Which of the following can NOT be the shape of Yimo’s constellation?

A. Kite B. Rectangle C. Trapezoid D. Square E. NOTA

30. The constellation Corona Borealis, whose name is Latin for northern crown, looks like a circle representing the base of a crown. What is the area of a circle with a radius of 4 inches?

A. 2π sq. in. B. 4π sq. in. C. 8π sq. in. D. 16π sq. in. E. NOTA

31. It is estimated that only about 4% of the universe is made up of stars, galaxies, and planets; the other 96% is made up of dark energy and dark matter. What is 96% as a fraction in simplest form?

1. B. C. D. E. NOTA

32. The star Proxima Centauri, which is part of the constellation Centaurus, is the closest star to our planet other than our own sun. It is approximately 40,208,000,000,000 kilometers away from Earth. Write the number 40,208,000,000,000 in scientific notation.

1. B. C. D. E. NOTA

33. There are 7 stars that make up the Big Dipper, which is part of the constellation Ursa Major. What is ?

1. 14 B. 64 C. 128 D. 256 E. NOTA

34. Polaris, more commonly known as the North Star, is estimated to be about 323 light years away. What is the largest proper divisor of 323?

1. 1 B. 17 C. 19 D. 37 E. NOTA