Team Name: _____ Round 1 Score: _____

Round 1: Planets and Moons

1. The population of an alien species on Kepler-22B increases by 4 individuals per minute. If the initial population at time $t = 0$ is 80, what will the units digit of the population be at $t = 3475$ minutes?

2. How many different ways can the letters in the word SATURN be arranged?

3. If 9 *zims* are equal to 4 *zams*, and 2 *zams* are equal to 3 *zoms*, then how many *zims* are equal to 2 *zoms*?

Team Name: _____ Round 2 Score: _____

Round 2: Constellations and Stars

1. The star Arcturus is located at (1, 1). The star Betelgeuse is located at (7, 1). The star Castor forms an equilateral triangle with Arcturus and Betelgeuse. What are the two possible y-coordinates of Castor? Express your answer in the simplest radical form.

2. The constellation Orion has less than 100 stars. Another constellation, Aries, has a prime number of stars. The ratio of stars in Orion to Aries can be written as 4:1. What is the largest number of stars that could be in Aries?

3. The space probe *Icarus* is on a journey to reach the star Proxima Centauri. Its journey through space can be modeled by the equation $2x^2 + ax$, where the location of Earth is represented as (0, 0). If it reaches Proxima Centauri at (10, 140), what is the value of a?

Team Name: _____ Round 3 Score: _____

Round 3: Black Holes and Gravitational Pull

1. The center of black hole Sagittarius A is located at (7, 4). The spacecraft *Asteria* falls into Sagittarius A, and its movement can be defined by the equation $y = ax + b$, where a is an integer between 3 and 5, inclusive. What is the sum of all possible values of a and b?

2. The space probe *Aurora* falls into black hole Phoenix A, accelerating at 12 m/s^2. Another probe, *Boreas*, falling into the smaller black hole Ansky, is accelerating at 5 m/s^2. Both probes begin at rest. After how many seconds will it take for *Aurora*'s speed to be 420 m/s faster than *Boreas*?

3. You're stuck on a spacecraft with a failing engine, and are pulled towards the M87 black hole. It will take 100110_2 (that's 100110 in base 2) minutes to deploy the minishuttle to safety, but you only have 2111_3 (that's 2111 in base 3) minutes until you cross the event horizon (the point of no return). Can you make it? (answer yes/no)

Team Name: _____ Round 4 Score: _____

Round 4: Galaxies and Nebulae

1. While looking for new star systems, you find the Cat's Eye Nebula and the Horsehead Nebula. The Cat's Eye Nebula is located at (50, 3) and the Horsehead Nebula is at (-30, -15). Assuming your spaceship travels at ⅕ the speed of light, and 1 unit is 1 light year, how long will it take to reach the Horsehead Nebula from the Cat's Eye Nebula?

2. The Milky Way spins clockwise at one revolution per 4 million years, and Andromeda spins clockwise at one revolution per 6 million years. In 2025, the Milky Way's longest arm points towards Andromeda, while Andromeda's longest arm is 240° clockwise from the Milky Way. After how many million years will the longest arms of both galaxies be pointing at each other? The arm must extend towards the other galaxy to "point" at it. Write your answer in million years (ex. answer 7 for 7 million years).

3. The magnitude of a celestial body is defined as its brightness. A newly formed galaxy has 7 stars, with magnitudes 2, 4, 7, 12, 12, 15, and x. If the mean, median, and unique mode of the magnitudes of the star in this galaxy are all the same, what is the value of x?

Team Name: _____ Round 5 Score: _____

Round 5: Space Exploration

1. The amount of fuel required to power the spacecraft Dragonfly VI happens to be in a specific sequence. For the first hour, it requires 3 tons of solid fuel; the second hour, 9 tons of solid fuel; the third hour, 27 tons of solid fuel; and so on. What is the total amount of rocket fuel Dragonfly VI would have used if it flew for 6 hours?

2. Every spaceship manufactured by Epsilon Enterprises is assigned a number, starting from 100 with an interval of 7. For example, the first five spaceships are assigned {100, 107, 114, 121, 128}. If Epsilon Enterprises manufactured 30 total spaceships, which spaceship was assigned the largest prime number? Provide your answer as a number between 1 and 30 (e.g. if the answer is the 30th spaceship, write 30).

3. It's your job to design your company's latest project - a cubic space probe with an edge length of 25 feet. You have enough paint to cover 1200 square feet, and decide to use all of the paint but only on the edge of each face so that the unpainted portion on each face is a square. The side length of one of those unpainted squares can be expressed in simplest form $a\sqrt{b}$. What is $a + b$?

Team Name: _____ Round 6 Score: _____

Round 6: Asteroids and Meteors

1. A probe from the Geminid meteor shower sends telemetry packets where each packet size forms an arithmetic sequence starting at 12 KB with common difference 5 KB. After 20 packets, what is the total data sent?

2. A cargo shuttle heading to the asteroid Pallas carries two types of materials: asteroids weighing 20 kg each and meteors weighing 12 kg each. If the shuttle can carry 220 kg total and has 15 total items, how many meteors can the shuttle ship?

3. A field of meteors is approaching Earth. Each meteor has a 75% probability of burning up in the atmosphere and a 25% chance of impacting our planet. If 5 meteors independently enter our atmosphere, what is the probability that exactly 3 meteors hit the surface? Answers should be a fraction in simplest form.

Team Name: _____ Round 7 Score: _____

Round 7: Alien Life

1. On the planet Celaeno, 60% of aliens have webbed fingers, while 15% of aliens have purple eyes. What is the probability of selecting an alien with webbed fingers and purple eyes? Express your answer as a common fraction.

2. The population of the Yoops, an alien species, grows by 50% every year. After 5 years, their population reaches 324 Yoops. What was their original population at year 0?

3. When Patrick searches for evidence of alien life on Mercury, he discovers a shrine consisting of a convex polygon. All faces of the shrine are hexagons and the polygon has 201 edges. How many faces does it have?

Team Name: _____ Round 8 Score: _____

Round 8: Parallel Universes

1. Scientists at NASA have designed a special type of coin to be used in parallel experiments. In our universe, the coin fairly lands heads or tails. In universe H46, the coin lands heads 46 times as likely as tails. In universe T67, the coin lands tails 67 times as likely as heads. If the coin is flipped once in all three universes, what is the ratio of the probability of the sequence {Tails, Heads, Heads} to the sequence {Heads, Heads, Tails}?

2. Dan has a red cap, a yellow cap, a green cap, and a blue cap. He also has a white shirt, a gray shirt, and a black shirt. He also has brown pants and purple pants. He has the choice to wear one cap, one shirt, and one pair of pants. In our universe, Dan wore a green cap, a white shirt, and brown pants. In another universe, Dan wore a new set of clothes. What is the probability that both Dans wore at least 2 of the same clothes? Express your answer as a simplest fraction.

3. There is one dwarf planet in the solar system MINILETE. A parallel solar system, MATHLETE, is exactly the same, except the scale of planet radius is changed. If the dwarf planet has a surface area 5 times less in MINILETE than MATHLETE, what is the ratio of the planet's volumes? Leave your answer unsimplified.

Team Name: _____ Round 9 Score: _____

Round 9: Time and Wormholes

1. Ryan discovers three planets that allow him to experience time faster (due to gravity) than on Earth. Every hour on planet A, 3 hours pass on Earth; every hour on planet B, 5 hours pass on Earth; and every hour on planet C, 6 hours pass on Earth. Ryan wants exactly 100 Earth hours to pass, and he must visit all three planets for a minimum of one hour, relative to the planet, for a whole number of hours. How many hours total should Ryan spend on all three planets to minimize his total time away from Earth?

2. Annie accidentally touches a time machine that sends her back in time. If she sees her previous self, she will die in the next year. If she interferes with her previous self, she has a 25% chance of dying in the next year. If she makes no interactions with her previous self, life will continue normally. She went through the time machine three times. What is the probability of her surviving the next year, assuming it is equally probable she will see, interact, or not interact with her previous self? Leave your answer as an unsimplified fraction.

3. Luke has discovered a new wormhole! This wormhole has an equal chance of taking him 1-2 minutes forward or backward in time. Luke goes through the portal three times without waiting. What is the probability he doesn't exist in the same minute twice?

Answers (only print once)

Round 1:

1. 0
2. 720
3. 3

Round 2:

4. $1 \pm 3\sqrt{3}$
5. 23
6. -6

Round 3:

7. -60
8. 60
9. YES

Round 4:

10. 410
11. 8
12. 32

Round 5:

13. 1092 (tons)
14. 20
15. 42

Round 6:

16. 1190 KB
17. 10
18. 45/512

Round 7:

19. 9/100
20. 64
21. 67

Round 8:

22. 1:67
23. 7/24
24. $\sqrt{5}$^3 or $5^{3/2}$

Round 9:

25. 18
26. 125/1728
27. 15/32