Fermi Questions Captains Tryouts Brookwood
ANSWER KEY

Part One:*Actual Fermi Questions*

5 points-exact answer
3 points-answer off by one
1 point- answer off by two

1. **8**
2. **9**
3. **10**
4. **-2**
5. **4**
6. **9**
7. **5**
8. **4**
9. **3**
10. **12**
11. **7**
12. **7**
13. **-7**
14. **6**
15. **-7**
16. **1**
17. **11**
18. **-4**
19. **8**
20. **16**
21. **6**
22. **-4**
23. **8**
24. **8**
25. **3**
26. **2**
27. **-19**
28. **-10**
29. **-1**

ANSWER KEY

30. **9**
31. **4**
32. **2**
33. **10**
34. **5**
35. **8**
36. **8**
37. **4**
38. **6**
39. **2567**
40. **-12**
41. **3**
42. **12**
43. **65**

Part Two(**note: The following are just one possible solution. The validity of solutions are up to the grader)**:**

15 points-exact answer
9 points-answer off by one
3 point- answer off by two
NO POINTS IF INVALID SOLUTION

44. **17**

First, consider the Schwartzchild Radius. For a sphere 1m in radius, the minimum mass contained in that sphere is given by the equation R = 2GM/c^2. Next, consider the mass extracted from one iteration of the process. Divide the mass you found through the Schwartzchild equation by the mass of salt you gathered in one iteration of your process, to find the total number of iterations needed. Multiply that number by 1000 years to find the total time it takes to create the salt ball and convert years to seconds

45. **8**

Recognize that a sun-like star has ~10^57 atoms, most of which is hydrogen. If the practically omnipotent aliens adds 6E23 atoms every 1E-24 seconds, every second, the aliens add 6E47 molecules. Multiply this amount by the time you got in question 44, and divide by the number of atoms in a sun-like star

46. **0**

The black plague killed 25 million Europeans, and heart disease has killed around 10 million people in the last two decades. To solve, simply divide number killed by black plague with the number killed by heart disease.

ANSWER KEY

47. **-1**

Consider Africa's population of 1.2 billion, and its reputation as a relatively undeveloped continent. Thus, the number of cars in the entire continent should be comparable to that of the US of ~300 million. Consider the average mileage of car per year of 20 mi/G and the average distance a car drives in a year of 10000 mi. From this, we get that the average car takes in ~2m^3 of gasoline each year, which translates to ~2000kg of gasoline. Using the combustion of gasoline equation, we can estimate that the gasoline mass input to CO2 mass output is 1:4, meaning an average car releases ~8000kg CO2 or ~8E6g CO2. Multiply this by the total number of cars in Africa, and divide that by the number of nanoseconds in a year, to get the answer.(Note that doubling your estimate of the number of cars should not change your fermi answer.)

48. **1**

The average CO2 intake of an average tree annually is ~20kg or ~20,000g. Multiply this by the total amount of trees on earth, ~3 trillion, to get an annual CO2 intake of ~ 6E16g CO2. Divide this by the number of nanoseconds in a year, and finally, by the answer you calculated in question 47.

49. **7**

A jump from n=2 → n=3 in hydrogen is a member of the Balmer series. Take the amount of available energy created by a cell in a second, and divide by the energy needed to ionize a single hydrogen electron.

50. **10**

It turns out that an average waffle house waffle has ~150 "abs" and waffle house serves ~150 waffles every second. Multiply those two figures, and by the number of seconds in a year to reach the answer.