

Fermi Questions - Key

SSSS 2017

Written by Justin72835 and Adi1008

Name(s): _____

Directions: Determine the answer to the following problems to the best of your ability to the **nearest power of 10**. For example, if you estimate the answer to a certain question to be 3×10^4 , then the **Fermi Answer** is $\boxed{4}$. Write your answers in the blank to the right of the question. Only numbers written in these blanks will be scored! You may use the space below each question for scratch work.

Scoring: A correct Fermi Answer is worth 5 points, an Fermi Answer 1 off is worth 3 points, and a Fermi Answer 2 off is worth 1 point. Fermi Answers off by 3 or more are worth 0 points. There is no penalty for guessing.

1. What is 2^{2017} ? 607
2. What is 12345×67890 ? 9
3. What is 17^{31} ? 38
4. What is $161 \times 294 \times 280 \times 438$? 10
5. What is $4 \uparrow\uparrow 3$? Note: The double up arrow ($\uparrow\uparrow$) signifies iterated exponentiation (referred to as tetration). Just like multiplication is repeated addition and exponentiation is repeated multiplication, tetration is repeated exponentiation. 154
6. Consider the partial sum of a harmonic series; that is, $1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{k}$. What is the minimum k such that the partial sum will be above 15? 6
7. What is the length of a covalent carbon-carbon bond, as a multiple of the height of the statue of liberty? -12

8. Consider the combustion of propane (C_3H_8). How many moles of propane would you need to combust in order to release the same amount of energy that the Sun outputs in an hour? Assume that oxygen (O_2) is in excess and that $\Delta H = -2221$ kJ/mol.
- 24
9. How many iron atoms are on the head of an iron pin?
- 13
10. How many nickels, stacked face to face, would it take in order to create a stack the length of a megaparsec?
- 25
11. How many seconds are in a year?
- 7
12. What is the mass of carbon dioxide produced from oil consumption worldwide each year?
- 13
13. How many African bush elephants would it take to equal the mass of the Virgo Supercluster of galaxies, including the Local Group?
- 41
14. How many carbon atoms would it take in order to create a single-file line of atoms from Istanbul to Moscow?
- 16
15. How many times larger is the acceleration due to gravity on the Moon's surface than the acceleration of a bullet in the barrel of a gun?
- 6
16. Divide the price of a new copy of Campbell's Biology 9th edition by the price of a B-2 Spirit stealth bomber
- 7
17. How many US dollar bills are needed to blanket the surface area of the Indian Ocean?
- 16
18. How many TI-Nspire calculators would it take to equal the mass of Sirius A?
- 31
19. At roughly what wind speed, in kilometers per hour, is the force on one's body from wind approximately equal to the weight of an average adult male?
- 2

20. How far, in femtometers, could a cheetah run at top speed in the time that the Sun has been a star?
33
21. How many Nexus 6p cellphones, stacked face to face, would you need to to have a stack with the same length as Betelguese's radius?
14
22. What is the radius of the observable universe divided by a Planck's length?
61
23. How many liters are in a barrel of oil?
2
24. How many barrels of oil does the US import every year?
9
25. How many heartbeats are there in a year for the entire world's population?
17
26. How many HIV-1 viruses would it take to equal the mass of the Empire State Building?
26
27. How many handcuffs would it take in order to create an interlocked chain from Boston, Massachusetts to Juneau, Alaska?
7
28. How many burgers were sold last year in America?
10
29. How many ping pong balls would it take to fill the Indian Ocean?
20
30. How many US dollar coins would fit in a bathtub?
5
31. What is the mass of Betelgeuse (a red supergiant of spectral type M1-2 in the constellation Orion) divided by the mass of Jupiter?
4
32. How many US dollar coins are needed to cover the surface of Pluto?
16

33. How many party balloons are needed to equal the volume of the troposphere?
21
34. How many many liters of water are contained in an averaged-sized cumulonimbus cloud?
6
35. How many US nickels would you need for the resulting Ni content from the nickels to be equal to the amount of Ni in the Earth's inner core?
25
36. How many liters of freshwater would you add to the Dead Sea to decrease its salinity to that of seawater?
12
37. How many grains of sand would be needed to fill the Empire State Building?
16
38. How many words were texted in the past year in the US?
13
39. What is the volume of air breathed by the whole US population each month?
13
40. How many kilograms of pizza were consumed last year in the US?
10
41. If a cup of water could be converted entirely into thermal energy, how many kilograms of ice could be melted?
11
42. If a weather balloon at sea level was taken to the bottom of the Atlantic Ocean, what would its new volume be in cubic meters?
-3
43. If you set the entire volume of water from Lake Michigan over a campfire, how many seconds would it take for the water to boil away?
18
44. How many copies of Giancoli, Physics: Principles with Applications 7th edition could be made with all the trees on the Earth?
14
45. How many leaves are in the Amazon Rainforest?

- 17
46. How many blades of grass are there in Central Park?
- 12
47. If all the humans on Earth crowded together, how much area would we cover in square kilometers?
- 3
48. What is the speed of Titan's orbit around Saturn in meters per second?
- 4
49. What is the thickness of a sheet of paper in terms of the wavelength of blue light?
- 7
50. If you were to take the DNA from every cell of an average-sized human body and uncoil it, then how many humans would you need for their DNA to stretch from Neptune to the Sun?
- 1
51. How many joules of energy are contained in a tablespoon of material from a neutron star?
- 29