

# FERMI QUESTIONS

School Name \_\_\_\_\_ **KEY** \_\_\_\_\_ Team # \_\_\_\_\_ **KEY** \_\_\_\_\_

Team Members \_\_\_\_\_ **KEY** \_\_\_\_\_

## Rules:

- Only writing utensils allowed. No calculators/cheat sheets/etc.
- Use ***scratch paper*** for any work that you do, and write your answers directly on the test. Make it clear which answer goes with which question. If you do write on the test for computation work, circle or box your answer. Basically, just make my life easier. thanks <3
- Give your answers in exponent form.
  - You will get a number which can be expressed in scientific notation as  $C \times 10^E$ , where  $0 < C < 10$ .
  - If  $C < 5$ , round down and put E.
  - If  $C \geq 5$ , round up and put  $E + 1$ .
  - Example answers
    - $4 \times 10^3 \Rightarrow 3$
    - $8 \times 10^{-2} \Rightarrow -1$
    - $5 \times 10^8 \Rightarrow 9$
- Points are awarded as follows:
  - 5 pts per correct answer
  - 3 pts per answer that is 1 off
  - 1 pt per answer that is 2 off
  - no pts otherwise
  - High score wins (obviously)
- Tiebreakers:
  - 1. Number of 5 pt questions
  - 2. Number of 3 pt questions
  - 3. Time
- Questions are ***not*** organized by difficulty. If you don't know how to solve a question, skip it, or guess, or something.

You can tear the test apart, but write your team number on top of all of your pages if you do so.

Good luck!

1. How many events are held in a typical Division C Science Olympiad competition?	1. <b>1. 23 <math>\Rightarrow</math> 1</b>
2. As of 2017, how many minutes of movie has Steven Spielberg directed?	2. <b>3. It's about 4300 minutes</b>
3. Assume that in a game of Rock-Paper-Scissors, the hands played by both participants are chosen completely randomly with an equal chance of choosing Rock, Paper, or Scissors. If the two choose the same hand, they do another round. What is the probability the two play the same hand exactly 72 times before finally declaring a winner? Note: a probability of $\frac{1}{2}$ can be written as 0.5	3. <b>-35. There's a <math>\frac{1}{3}</math> chance every time that they play the same hand, and a <math>\frac{2}{3}</math> chance that someone wins. so the answer is <math>(\frac{1}{3})^{72} * \frac{2}{3} = 2.96 * 10^{-35}</math></b>
4. What is the pH of rain?	4. <b>1. The pH of rain is about 5.5-7</b>
5. What is the net worth of Apple, Inc., in Mexican pesos?	5. <b>13 current net worth of Apple <math>\sim</math> \$900 B, which goes to about 1666809000000.00 pesos (dated 2/17/18)</b>
6. How many standard packs of Bicycle playing cards would it take to completely cover Jupiter?	6. <b>20. 1 playing card is about 2.5" x 3.5", 54 cards makes 472.5 sq inches per deck. Jupiter's surface area is 23,713,907,537 square miles. This comes out to 201.5 quadrillion decks needed, or <math>2.015 * 10^{20}</math></b>
7. What is the surface area of an iPhone 7, in hectares?	7. <b>-6. Dimensions are 138.3 mm x 67.1 mm x 7.1 mm <math>\Rightarrow</math> S.A. = <math>21,477 \text{ mm}^2 = 2.15 * 10^{-6}</math> hectares</b>
8. How many human skin cells, laid end to end, would it take to reach from here to the Science Olympiad National Tournament in Fort Collins, Colorado?	8. <b>11. Fort Collins <math>\rightarrow</math> Detroit = 1846 km. human skin cell = 30 micrometers. <math>1846 \text{ km} / 30 \text{ micrometers} = 6.153 * 10^{10}</math></b>
9. What is the overall product of the lengths of the first names of everyone who is taking Fermi at this competition? (For example, if Bob, Mary, and Joseph are the only ones competing in Fermi, the answer would be $3 * 4 * 6 = 72 \Rightarrow 2$ ) Please note that I will be using the names	9. <b>varies, final answer 58</b>

written on the front pages of these tests to calculate the answer to this question.	
10. $26^9$	10. <b>13.</b> The answer is $5.43 \times 10^{12}$
11. How many full rolls of toilet paper could fit inside the White House?	11. <b>7.</b> White House dimensions: 168 ft x 85 ft x 65 ft = 928,200 ft <sup>3</sup> . 1 roll of toilet paper is about 10 cm wide and 12 cm diameter, or 6 cm radius $\Rightarrow$ 1130.97 cm <sup>3</sup> . $\Rightarrow$ $2.32 \times 10^7$ rolls
12. What is the mass of a mole (unit) of moles (animal), in ounces?	12. <b>24.</b> It comes out to $4.52 \times 10^{22}$ kg, or $1.594 \times 10^{24}$ oz. ( <a href="https://what-if.xkcd.com/4/">https://what-if.xkcd.com/4/</a> )
13. What is the density of four-year colleges in the United States, per square meter?	13. <b>-10.</b> 3004 4-year colleges. ( <a href="https://nces.ed.gov/programs/digest/d16/tables/dt16_31_7.20.asp?current=yes">https://nces.ed.gov/programs/digest/d16/tables/dt16_31_7.20.asp?current=yes</a> ) area of USA = 9,833,520 km <sup>2</sup> . Result = $3.055 \times 10^{-10}$ colleges/m <sup>2</sup> .
14. If the population of Michigan were to continue growing at its current growth rate for eternity, how many years from now would it take for its population to reach the current population of the world?	14. <b>3.</b> It comes out to about 1000 years.
15. What is the perimeter of Manhattan, in terms of the wavelength of red light?	15. <b>11.</b> The perimeter of Manhattan is 32 mi. The wavelength of red light is about 700 nm. $32 \text{ mi} / 700 \text{ nm} = 7.357 \times 10^{10}$
16. How many credit cards would fit in the Earth's stratosphere?	16. <b>25.</b> The dimensions of a credit card are 85.6 mm x 53.98 mm x 0.76 mm $\Rightarrow$ 3510 mm <sup>3</sup> or 3.51 mL. Assuming the earth and the layers of the atmosphere are perfect spheres: Earth's radius is 3959 mi, the stratosphere starts 10 km above sea level and ends at 50 km. Calculating the volume of the stratosphere like this gives 2.06 billion km <sup>3</sup> or $2.06 \times 10^{22}$ L. $2.06 \times 10^{22} \text{ L} / 3.51 \text{ mL} = 5.869 \times 10^{24}$ .
17. A sample of pure iridium weighs as much as a loaf of bread. How many atoms of iridium are in the sample?	17. <b>24.</b> Loaf of bread = 700 g. Iridium molar mass = 192.217 g/mol. $700 \text{ g} / (192.217 \text{ g/mol}) * 6.022 * 10^{23} \text{ atoms/mol} = 2.193 \times 10^{24}$
18. At what speed would a standard brick have to travel in order to have the same kinetic energy as a Ping-Pong ball travelling at a cheetah's top speed? Give your answer in km/hr.	18. <b>0.</b> The ping-pong ball would have energy 1.5 J ( <a href="http://www.wolframalpha.com/input/?i=1%2F2+*+(pi+ng+pong+ball+mass)+*+(cheetah+top+speed)+%5E2">http://www.wolframalpha.com/input/?i=1%2F2+*+(pi+ng+pong+ball+mass)+*+(cheetah+top+speed)+%5E2</a> ). A brick is about 2.7 kg. So the resultant speed is 1.05 m/s = 3.78 km/hr

19. What is the file size of the original Pokémon Red, in terms of the file size of the total article text of the English Wikipedia?	19. <b>-4.</b> $1 \text{ MB} / 12 \text{ GB} = 8.33 * 10^{-5}$
20. On average, how many times has Luis Fonsi's <i>Despacito</i> been watched on YouTube per day since it was uploaded?	20. <b>7.</b> currently Despacito has been watched 4,834,063,531 times. It was uploaded on 1/12/17 which results in 401 total days (as of 2/17/18). $\Rightarrow 1.2055 * 10^7$ views per day
21. What is the diameter of an electron, in light years?	21. <b>-32.</b> Electron diameter = $9.087345835484 * 10^{-17} \text{ m}$ $= 9.60553729 \times 10^{-33}$ light years
22. How many March Madness brackets would each member of the US Congress have to fill out in order to guarantee that someone has a perfect bracket? You can assume that each member of Congress fills out the same number of brackets and that all filled-out brackets are unique.	22. <b>16.</b> Number of March Madness brackets possible = $2^{63} = 9.22 \times 10^{18}$ . Number of Congress members = 535. This ultimately gives us $1.724 \times 10^{16}$ .
23. If every person who ever lived crowded together in one spot, how much area would be covered, in terms of the area of Rhode Island?	23. <b>1.</b> 100 billion people would take up about 7000 sq mi. Rhode Island is approximately 1212 sq mi, so it's about 5.77 Rhode Islands. [Note: this answer was originally incorrect (-1) on the key but due to a ridiculous amount of luck, the tests were graded with this question having an answer of 1 due to negative signs being difficult to see]
24. How many individual fries does McDonald's sell every year?	24. <b>12.</b> McDonald's sells 9 million pounds of fries a day ( <a href="https://www.factretreiver.com/mcdonalds-food-facts">https://www.factretreiver.com/mcdonalds-food-facts</a> ) and 10 fries is about 0.75 oz. This gives $1.92 * 10^9$ fries per day, or $7.008 * 10^{11}$ fries per year.
25. How many pennies would it take to create a walkable bridge from Boston, MA to Portugal, assuming that pennies sink (and that you therefore must stack pennies from the bottom of the ocean floor)?	25. <b>16.</b> Distance from Boston to Portugal = 3211 mi. 6 inches is approximately walkable. The average depth of the Atlantic is 3,926 meters. We assume the pennies must make a rectangular prism of this volume (comes out to $3.09 \times 10^9 \text{ m}^3$ ) The diameter of a penny is 19 mm and the thickness is 1.52 mm, giving a volume of $431 \text{ mm}^3$ . Result = $7.17 \times 10^{15}$
26. How many more square centimeters is the area of the earth in the flat earth model, compared to the area of the earth in real life? Useful note: The most common flat earth model represents the earth as a disk, with the North Pole at the center and the "South	26. <b>19.</b> Assuming Earth is a sphere: Radius = 3959 mi, S.A. comes out to $1.97 * 10^8 \text{ mi}^2$ . Assuming Earth is a circle: The distance from N.Pole to S.Pole = $\frac{1}{2}$ circumference = 12,438 mi. Treating this as the radius gives $4.86 * 10^8 \text{ mi}^2$ . Doing necessary calculations gives $7.485 * 10^{18} \text{ cm}^2$

Pole” at the edge.	
27. How many exa-newtons of force does the Earth’s gravitational field apply on a single grain of rice located on the surface of the Moon?	27. <b>-25.</b> $1.838 * 10^{-25}$ exanewtons
28. You are in space and are unaffected by gravity (yes you are still breathing, don’t ask how). You want to get from the Sun to the next closest star, so you throw your shoe in the correct direction. How many minutes would it take for you to get there?	28. <b>15.</b> from internet research it seems safe to assume the average high schooler could throw a shoe at about 50 mph. if we average a shoe’s mass at about 2.5 lbs, we get the resultant momentum to be 25.3 N s. The average high schooler is about 125 lb, so we get a resultant velocity of 1 mph or .447 m/s. The closest star is about 4.22 light years away, giving a time of $1.488 * 10^{15}$ min
29. How many times does the string “cell” appear in Campbell’s Biology, 9th edition? (Note: any word that contains “cell”, such as “intracellular” or “cellulose”, would count)	29. <b>3.</b> It appears 2,955 times
30. How many terabytes is this test, when converted to PDF format?	30. <b>-7.</b> The test is 222 kB $\Rightarrow 2.22 * 10^{-7}$ TB
31. How many standard AAA batteries would it take to equal the total installed wind energy capacity of the world?	31. <b>5.</b> wind energy capacity = 486,790 Watts, AAA battery = $\sim 2$ W. $\Rightarrow 2.43 * 10^5$
32. How many cells are in the typical human body?	32. <b>13.</b> Commonly accepted number is about 37 trillion
33. If you took the hair from the heads of every student enrolled at the University of Michigan, how many pounds of hair would you have?	33. <b>4 -</b> average amount of hair = 100,000 hairs, an average 9” long hair is about 1.2 mg, there are 44,718 students at UM $\Rightarrow 5.3$ billion mg $\Rightarrow 11,684$ lb
34. An average-sized blue whale is actually a mutant - it can stay suspended in pure helium without sinking or rising. What is its mass, in solar masses?	34. <b>-29</b> blue whale volume is about $140 \text{ m}^3$ . helium density is $0.164 \text{ kg/m}^3 \Rightarrow 22.96 \text{ kg} \Rightarrow 1.1547 \times 10^{-29}$ solar masses
35. How many results turn up when “University of Michigan Science Olympiad” is Googled?	35. <b>5.</b> total number of results is $\sim 161,000$
36. Estimate your score for the first 35 problems.	36. answer varies between 0,1,2