

Fermi Answer Key

1. **32** $1.989 \times 10^{30} \text{ kg/sun} \times 1000 \text{ g/kg} \times 1 \text{ sheet of paper}/4.536 \text{g} = 4.38 \times 10^{32} \text{ sheets of paper/sun}$
2. **30** $4.38 \times 10^{32} \text{ sheets of paper/stack} \times .097 \text{mm/sheet of paper} \times 1 \text{cm}/10 \text{mm} = 4.25 \times 10^{30} \text{ cm/stack}$
3. **25** $25! = 1.55 \times 10^{25}$
4. **13** $19.05 \text{mm/diameter of penny} \times 1 \text{m}/1000 \text{mm} \times 1 \text{fm}/1 \times 10^{15} \text{m} = 1.91 \times 10^{13} \text{ fm/diameter of penny}$
5. **9** $\$1.99 \times 10^{13} \text{ debt} \times 1 \text{ F-150}/\$27110 = 7.34 \times 10^8 \text{ F-150s}$
6. **7** $40,075 \text{km/circumference of Earth} \times 1000 \text{m/km} \times 1 \text{ intestine}/6 \text{m} = 6.68 \times 10^6$
7. **5** $487.6 \text{kg/bench} \times 1000 \text{g/kg} \times 1 \text{mL}/1 \text{g} = 4.88 \times 10^5 \text{ mL/bench}$
8. **2** 102 times... yes, migos are lyrical geniuses
9. **7** $7.7 \times 10^6 \text{ dislikes... yes, it has more dislikes than likes}$
10. **1** $36000 \text{ feet/trench} \times 1 \text{ tower}/984 \text{ feet} = 36.6 \text{ towers/trench}$
11. **24** 1 mole = 6.02×10^{23}
12. **0** 1 mole of atoms/1 mole of atoms = 1 (Remember, $1 = 1 \times 10^0$)
13. **47** $6.02 \times 10^{23} \text{ atoms/ball} \times 6.02 \times 10^{23} \text{ balls/mol of balls}$
14. **24** $87.9 \text{g/mole(animal)} \times 1 \text{ mol Carbon}/12.011 \text{g} \times 6.02 \times 10^{23} \text{ C atoms/1 mol Carbon} = 4.4 \times 10^{24} \text{ C atoms/mole(animal)}$
15. **-14** $50 \text{m/pool} \times 1 \text{ ly}/9.46 \times 10^{15} \text{m} = 5.29 \times 10^{-15} \text{ ly/pool}$
16. **-4** $\$1.5 \times 10^7 / \$1.5 \times 10^{11} = 1 \times 10^{-4}$
17. **5** The number is around $15500 \text{ days} \times 24 \text{hr/day} = \text{around } 372,000 \text{ hours}$
18. **22** $18^{18} = 3.9 \times 10^{22}$
19. **24** $4 \times 10^{26} \text{ watts}/100 \text{watt bulbs} = 4 \times 10^{24} \text{ bulbs}$
20. **-2** $10 \text{ feet} \times 1 \text{mile}/5280 \text{feet} \times 1 \text{hr}/268 \text{miles} \times 60 \text{min/hr} \times 60 \text{ sec/min} = 2.54 \times 10^{-2} \text{ sec}$
21. **4** $1.5 \times 10^6 \text{ calorie intake}/1.5 \times 10^2 \text{ calories per twinkie} = 1 \times 10^4 \text{ twinkies}$
22. **3** The note is an A5, which has a frequency of 880Hz
23. **-4** $11 \text{cm} \times 1 \text{m}/100 \text{cm} \times 1 \text{km}/1000 \text{m} = 1.1 \times 10^{-4} \text{ km}$
24. **3** $1 \times 10^{12} \text{ bytes}/7 \times 10^8 \text{ byte genome} = 1.4 \times 10^3 \text{ genomes}$
25. **-7** $F = Gm_1m_2/r^2 = (6.67 \times 10^{-11})(50 \text{kg})(50 \text{kg})/(1 \text{m})^2 = 1.67 \times 10^{-7} \text{N}$
26. **20** the ball has $.7 \text{m circumference}/2\pi = .111 \text{m radius}$, $4/3\pi(.111)^3 = 1.84 \times 10^{-3} \text{ m}^3 \text{ volume}$, the pacific has $7.1 \times 10^8 \text{ km}^3 \text{ volume}$ which is $7.1 \times 10^{17} \text{ m}^3$, $7.1 \times 10^{17}/1.84 \times 10^{-3} = 3.85 \times 10^{20} \text{ balls}$
27. **8** $384,400 \text{km} \times 1000 \text{m}/1 \text{km} \times 49.82 \text{sec}/100 \text{m} = 1.9 \times 10^8 \text{ sec}$
28. **5** $481103 \text{ words} \times 1 \text{min}/100 \text{words} \times 60 \text{sec}/1 \text{min} = 2.9 \times 10^5 \text{ sec}$

- 29.-9** $8851.8\text{km} \times 1\text{ly}/9.5\text{e}12\text{km} = 9.3\text{e}-10\text{ly}$
- 30.2** 206 bones
- 31.11** 215.64 billion dollars
- 32.13** 22,459,157,718,361 digits (by Peter Trueb)
- 33.9** >1 billion in 2015, unlikely to have reached 5 billion in one day
- 34.6** $3\text{e}8/340 = 8.8\text{e}5$
- 35.9** $9.3\text{e}7\text{mi} \times 1\text{hr}/.029\text{mi} = 3.2\text{e}9 \text{ hr}$