2005 CLEARVIEW, OH, REGIONAL FERMI QUESTIONS ANSWER KEY

WRITE YOUR ANSWERS * EXPONENTS ONLY *** TO THE RIGHT OF THE APPROPRIATE QUESTION NUMBER ON THIS SHEET. CALCULATORS, SLIDE RULES, CRIB SHEETS, ETC. ARE NOT ALLOWED!!** If any one of these items is used during the event, the team will be disqualified.

Example 1: How many seconds are there in one year? $1 \cdot 10^{7}$ **Answer: 7**

Example 2: How many kilometers are in a millimeter? $1 \cdot 10^{-6}$ **Answer: -6**

1. 1

2. -7

3. 5

4. 2

5. 6

6. -5

7. -12

8. 7

9. -9

10. 3

11. 7

12. 7

13. 13

14. 8

15. -1

16. 4

17. 0

18. -22

19. 9

20. 5

21. 8

22. 1

23. -4

24. -1

25. 11

26. -6

27. -11

28. -7

29. 10

30. 10

31. 7

32. 2

33. 4

34. 7

35. 19

36. -26

DO NOT WRITE BELOW THIS LINE

Score _____ Number Correct _____

Answer Sheet was turned in at: _____ Lapsed Time: _____

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1. How many cases of food-borne botulism occur in the United States annually? Average is about 25 per year (CDC) or $\mathbf{10^1}$

2. What is the lethal dose of botulism toxin, in grams, for a 150 pound human? 150 lb(1kg/2.2lb)(1ng/kg)= $6.8 \cdot 10^{-8}$ or rounded to $\mathbf{1 \cdot 10^{-7}}$
http://www.infinite-justice-news.com/infinite/bio/biobotulism.htm

3. According to the Census of Marine Life, what is the estimated number of life forms in the world's oceans? 230000 or $\mathbf{1 \cdot 10^5}$

4. How many different species of fish did the Census of Marine Life discover in the past year? 178= $\mathbf{1 \cdot 10^2}$

5. How many Christmas trees were produced in Ohio last year? 800,000 $\mathbf{1 \cdot 10^6}$
http://www.realtrees4kids.org/faq.htm#work

6. If one were to move closer and closer while observing isolated blood cells, at what distance, in meters, would they first come into clear view? $\mathbf{1 \cdot 10^{-5}}$

7. If one were to move closer and closer to a carbon atom, at what distance, in meters, would the nucleus appear? $\mathbf{1 \cdot 10^{-12}}$

8. At what distance from Earth's surface, in meters, can an astronaut observe the entire hemisphere directly beneath him/her? $\mathbf{1 \cdot 10^7}$

9. In 1983, more than 300 years after the first serious measurement attempt, the Seventeenth General Congress on Weights and Measure defined the meter as the distance light travels through a vacuum during a time interval of how many seconds? 1 m = distance traveled in 1/299,792,458 seconds or 3.33 10^{-9} seconds. Or $\mathbf{1 \cdot 10^{-9}}$

10. How much voltage can a large electric eel produce? 600+ v or $\mathbf{1 \cdot 10^3}$

11. Up to how many MeVs may the energy of gamma rays extend during the course of nuclear reactions when initiated by low energy particles? 20 MeV
http://hypertextbook.com/facts/1999/JonathanStarr.shtml

12. What is the distance, in meters, of a satellite in geosynchronous orbit about the Earth? 1 geosynchronous orbit = 6.5 earth radii ($6.4 \cdot 10^6$ m) = $4.16 \cdot 10^7$ or $\mathbf{1 \cdot 10^7}$
http://hypertextbook.com/physics/mechanics/displacement

13. What is the distance, in meters, from the sun to Pluto? 40 AU ($1.5 \cdot 10^{11}$m/AU) = $6 \cdot 10^{12}$ m or $\mathbf{1 \cdot 10^{13}}$ http://hypertextbook.com/physics/mechanics/displacement/

14. According to the U.S. Bureau of the Census, what was the resident population of the United States on January 1, 2005? 295,164,504
http://www.census.gov/cgi-bin/popclock $2.9 \cdot 10^{8}$ or $\mathbf{1 \cdot 10^{8}}$

15. What is the average diameter of a human hair in millimeters? 70µm or $7 \cdot 10^{-5}$µm ~ $\mathbf{1 \cdot 10^{-1}}$mm

16. How many square kilometers of Lake Erie are solely under the jurisdiction of the USA? $13036 km^2$ http://www.census.gov/prod/2004pubs/04statab/geo.pdf p.7 Or $\mathbf{1 \cdot 10^{4}}$

17. A 15.0 cm long cylindrical glass tube, sealed at one end, is filled with ethanol (d=.789g/ml). The mass of ethanol needed to fill the tube is found to be 9.64g. What is the inner diameter of the tube, in centimeters? 1.02 cm or $\mathbf{1 \cdot 10^{0}}$

18. What is the mass, in grams, of all the hydrogen atoms in 5.0 molecules of sucrose, $C_{12}H_{22}O_{11}$? (5 molecules/ $6.02 \cdot 10^{23}$molecules/mole) = $8.3 \cdot 10^{-24}$ moles (22 gH / 1 mole sugar) = $\mathbf{1 \cdot 10^{-22}}$ **g**

19. Municipal Solid Waste Generation has become a big problem. How many pounds of landfill waste would be generated by the population of Cuyahoga county in one year? (2.5 pounds/day per person)(365 days/year)(1,400,000 persons)= $\mathbf{1 \cdot 10^{9}}$
http://www.cuyahoga.oh.us/common/ and
http://www.census.gov/prod/2004pubs/04statab/geo.pdf p. 12

20. What was the number of injuries, in 2001, from skateboards in the U.S.? [Estimates calculated from a representative sample of hospitals with emergency treatment departments in the United States. Data are estimates of the number of emergency room treated cases nationwide associated with various products. Product involvement does not necessarily mean the product caused the accident.]
104449 or $\mathbf{1 \cdot 10^{5}}$ http://www.census.gov/prod/2004pubs/04statab/health.pdf p. 31

21. What is the annual consumption of ice cream, in pounds, for the State of Ohio?
http://www.census.gov/prod/2004pubs/04statab/health.pdf 16.7 pounds/person x (11,435,798 Ohio population) = $1.9 \cdot 10^{8}$ or $\mathbf{1 \cdot 10^{8}}$

22. What is the ratio, in meters, of the highest and lowest points in Colorado compared to the highest and lowest points in Minnesota?
CO.. . . . . Mt. Elbert . . . . . 4,402m Arkansas River 1,022m
MN. . . . . Eagle Mountain, Cook Co . 702m Lake Superior. 183m
(4402-1022)/(702-183) = 6.5 or rounded to 10 or $\mathbf{1 \cdot 10^{1}}$
http://www.census.gov/prod/2004pubs/04statab/geo.pdf p6

23. What is the average rate of continental drift, in meters per day, along the Mid-Atlantic Ridge? 2.5 cm/year (1m/100cm) (1yr/365 days) = $6.8 \cdot 10^{-5}$ ~ $\mathbf{1 \cdot 10^{-4}}$ m/day
http://pubs.usgs.gov/publications/text/understanding.html

24. Determine the density of oxygen in the air of this room at 25°C and 760 torr in g/L. At STP mass of air is 1.288 g/L but at the temperature given (ideal gas law) it is 1.18g/L. Since the percent of oxygen in the air is considered to be 21% then the density of air is 1.18g/L (.21) = .25 g/L oxygen. Or $\mathbf{1 \cdot 10^{-1}}$

25. How many total kg of carbon monoxide were produced in 2001 in the US as Air Pollutant Emissions? 120,760,000 tons (2000lbs/ton) (1 kg/2.2 lbs) = $\mathbf{1.10^{11}}$ http://www.census.gov/prod/2004pubs/04statab/geo.pdf p. 12

26. What fraction of a cubic meter is a milliliter?
$1m^3 = 1000L = 1000000ml$ or $\mathbf{1 \cdot 10^{-6}}$

27. What is the length, in meters, of the shortest form of an X-ray wavelength?
0.03nm ($1m/1 \cdot 10^9 nm$) or $3 \cdot 10^{-11}$ or $\mathbf{1 \cdot 10^{-11}}$

28. What is the range, in meters, between the longest and shortest wavelengths of visible light within the electromagnetic spectrum? 750 nm (red)-400 nm (violet) = 350nm ($1m/1 \cdot 10^9 nm$) = $3.5 \cdot 10^{-7}$ or $\mathbf{1 \cdot 10^{-7}}$

29. How many breaths does the average U.S. adult take in a lifetime?
76.5 years (365 days/year)(24 hours/day)(60 min/hour)(25 breaths/min)= $8 \cdot 10^9$ or $\mathbf{1 \cdot 10^{10}}$

30. How many seconds were cell phones used in 2003 by the U.S. population?
159 million in 2003 and the average cell phone call in 2003 lasted 2.87 minutes from US Census Bureau = $2.7 \cdot 10^{10}$ or $\mathbf{1 \cdot 10^{10}}$

31. How many organic and inorganic substances were registered with the Chemical Abstracts service as of Jan.1, 2005? (25,116,162) or $\mathbf{1 \cdot 10^7}$
http://www.cas.org/cgi-bin/regreport.pl

32. What is the number of somatic cells in a 49 day old, normally developing fetus?
210 = $\mathbf{1 \cdot 10^2}$

33. How many genes are currently considered part of the human genome?
20,000-25,000 = $\mathbf{1 \cdot 10^4}$

34. The diameter of a chromium atom is about 2.4 Å (10 Å = 1nm). How many chromium atoms would have to be lined up to span 1.0 cm? $4.2 \cdot 10^7$ or $\mathbf{1 \cdot 10^7}$

35. How many hydrogen atoms are present in 1 mg of aspartame ($C_{14}H_{18}N_2O_5$), the artificial sweetener? $3.68 \cdot 10^{19}$ or $\mathbf{1 \cdot 10^{19}}$

36. What is the mass, in grams, of all the electrons of a copper atom? $9.1 \cdot 10^{-28}$g x 29 = $\mathbf{1 \cdot 10^{-26}}$**g**