

\*\*\*\*\*ANSWER KEY FOR THE UNITS OF MEASUREMENT CONVERSIONS TO SI\*\*\*\*\*

## Díaz units of measurements

Hi, my name is Tomás Díaz, your event supervisor for today's Fermi Questions. I decided to have some fun, add a twist and make my own narcissistic unit of measurement for different quantities: The **Díaz**. This unit will be used for different quantities or types of measurements throughout the exam. The table below contains an explanation of each of the units and a space for each where you can enter the equivalent value of 1 Díaz for its respective SI or derived SI unit to help you use it in your calculations. This sheet will not be scored and it is only meant to help you with this unusual system of measurement. It is after all an unusual unit of measurement.

















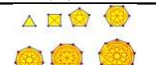





(Enter your conversion factors here in non-Fermi answers. That is, if 1km is 1000meters, enter 1,000 instead of 3)

Base or Derived Quantity	Description	SI or SI derived equivalency		
<b>Length</b>	Height of Mr. Díaz	1 Díaz =	as measured = 1.8m Students may use 2m	<b>Meters</b>
<b>Volume</b>	Volume of Mr. Díaz	1 Díaz =	Using density of water: $90\text{Kg} / (1000\text{Kg}/\text{m}^3) = 0.09\text{m}^3$	<b>Cubic Meters</b>
<b>Mass</b>	Mass of Mr. Díaz	1 Díaz =	$90\text{Kg} = 90000\text{grams}$	<b>Grams</b>
<b>Force</b>	Gravitational force that Mr. Díaz exerts on Earth at water level.	1 Díaz =	$90\text{Kg} * 9.81\text{m}/\text{s}^2 = 883\text{N} \approx 900\text{N}$	<b>Newton</b>
<b>Energy</b>	The average daily amount of energy that Mr. Díaz spends	1 Díaz =	$100\text{W} * 24 \text{ hours} * 3600 \text{ seconds}/\text{hour} = 8.64\text{e}6\text{J} \approx 9\text{e}6\text{J}$	<b>Joules</b>
<b>Power</b>	The amount power Mr. Díaz produces at rest.	1 Díaz =	average for a human = 100W	<b>Watts</b>
<b>Temperature</b>	The temperature of Mr. Díaz at rest with zero Díaz equal to the absolute zero.	1 Díaz =	average for a human = $37^\circ\text{C} + 273 = 310\text{K}$	<b>Kelvin</b>
<b>Pressure</b>	The amount of pressure Mr. Díaz exerts on the ground when wearing normal shoes.	1 Díaz =	$883\text{N} / (0.04\text{m}^2) = 22\text{e}3\text{Pa}$	<b>Pascals</b>
<b>Electric current</b>	The amount of current needed to kill Tomas Diaz	1 Díaz =	average for a human = 0.15Amps	<b>Amperes</b>
<b>Frequency</b>	Heart beats per unit of time that Tomas produces at rest.	1 Díaz =	approximately 1 heart beat every second = 1Hz	<b>Hertz</b>
<b>Time</b>	Total time that Mr. Diaz has been alive.	1 Díaz =	$49 \text{ years} * 3\text{e}7 \text{ s}/\text{year} = 1.5\text{e}9\text{s}$ (students can use 50 years also)	<b>Seconds</b>
<b>Speed</b>	The average speed that Mr. Díaz can run a marathon	1 Díaz =	$26\text{miles} / (4.5\text{hours}) \approx 2.5\text{m}/\text{s}$	<b>Meters per second</b>
<b>Angular Velocity</b>	The angular velocity of Mr. Díaz, while on Earth around the Sun	1 Díaz =	$2\pi / (1\text{year}) = 2\pi / (3\text{e}7\text{s})$ $\approx 2\text{e}-7\text{rad}/\text{s}$	<b>radians per second</b>
<b>Volumetric Flow Rate</b>	The volumetric flow rate of Mr. Díaz' heart at rest	1 Díaz =	average for human is 5 liters of blood per minute at rest $\approx 8.5\text{e}-5\text{m}^3/\text{s}$	<b>Cubic Meters per second</b>
<b>Brain capacity</b>	Total amount of neurons in Mr. Diaz's brain.	1 Díaz =	average human brain $\approx 1\text{e}11$	<b>Neurons</b>
<b>Currency</b>	The amount of US dollars that Mr. Díaz' Amazon stock holdings would been worth today if he wouldn't have sold his \$5000 worth of Amazon stock at the end of 1997.	1 Díaz =	AMZN price today $\approx \$150$ AMZN price end of 1997 $\approx \$0.20$ $\$5000 * (\$150 / \$0.2) \approx \$3.7\text{e}6$ Yup! I should have hold on to it.	<b>US Dollars</b>
<b>Molecular</b>	Amount of molecules of Mr. Díaz	1 Díaz =	average human molecules $\approx 1\text{e}27$	<b>Molecules</b>
<b>Unitless</b>	No units, one Díaz = 1	1 Díaz =	1	<b>unit</b>

2024 Plymouth Canton Invitational. Fermi Questions.

\* NOTE: Please refer to the Díaz units of measurements page so that you can use the appropriate Díaz units in these Fermi Questions

Q	Illustration	Fermi Question	F.A.
1		What is the brain capacity in Díaz of Mr. Díaz's cat's brain? (yes, that's a picture of my cat on the left) A: Cats have 300 million neurons. $300e6/1e11=3e-3$ .	-3
2		How many Díaz of current does it take to operate a standard electric stove in a house? A: electric ranges use from 40amps to 60 amps. $50\text{amps}/(0.15\text{amps})\approx 3e2$	2
3		How many Díaz of power do you need to run a Tesla at highway speeds? A: About 15kW. $15e3/100\approx 1.5e2$	2
4		What is the mass of the Earth in Díaz? A: Mass of Earth is about 6e24kg. $6e24/90\text{Kg}\approx 6.6e22\approx 1e23$	23
5		What is the Volume of the Earth in Díaz? A: radius of Earth is about 6.3e6m. $V=4\pi/3(6.3e6)^3\approx 1e21\text{m}^3$ . Hence, $1e21/1e-1\approx 1e22$	22
6		What is Earth's rotational speed in Díaz units of angular velocity? Earth spins 365 times around it's axis for every one time around the Sun. Hence in Díaz = $365\approx 3.6e2$	2
7		What is Earth's core temperature in °Díaz? A: Core is 5,200°C. Hence $(5.2e3+273)/310\approx 1.77e1$	1
8	Yotta-yocto?	How many YottaDíaz in one yoctoDíaz? (Which Díaz unit of measurement is irrelevant on this question) A: one YottaDíaz=1e24Díaz. One yoctoDíaz=1e-24Díaz. Hence, $\text{yoctoDíaz}/\text{YottaDíaz}=1e-24/1e24=1e-48$	-48
9		What is the box office sales of that horrible movie Barbie that my wife dragged me to see with her in Díaz? A: $\$1.4e9/\$3.7e6\approx 3.7e2$	2
10		The amount of time in Díaz that my wife made me waste watching that horrible Barbie movie including the driving time to the theater and getting ready to go out? A: 2hr movie+1hr ready= $3\text{hr}\cdot 3600(\text{s}/\text{hr})/(1.5e9\text{s})\approx 7e-6\approx 1e-5$	-5
11		What is the age of the Universe in Díaz? A: $13.7e9 \text{ years}/49\text{years}\approx 2.8e8$	8
12		How many Díaz molecular units of molecules of water in the atmosphere? A: 0.001% of H <sub>2</sub> O in atm by vol. Height $\approx 10e6\text{m}$ . $V\approx (1e-5)\cdot 4\pi(6.3e6\text{m})^2(10e6\text{m})\approx 5e16\text{m}^3$ . $\text{molcs}=5e16\text{m}^3(1e6\text{g}/\text{m}^3)/(18\text{g}/\text{mol})\cdot 6e23\text{mol}^{-1}/1e27\approx 1.6e18$	18
13		How many Díaz molecular units of molecules of sugar are in one standard can of Coca Cola? A: $(39\text{g})/(350\text{g}/\text{mol})(6e23\text{mol}^{-1})/1e27\approx 6.8e-5\approx 1e-4$	-4
14		In Díaz, what's the frequency of your favorite FM radio station? A: FM range: 88-108 MHz = $0.8e8\rightarrow 1.08e8\text{Hz}=0.8e8\rightarrow 1.08e8$ Díaz	8
15		In Díaz, what's the wavelength of your favorite FM radio station wave? A: $(\text{speed of light})/(1e8\text{Hz})/(1.8\text{m})=(3e8\text{m}/\text{s})/(1.8\text{Hz})/(1.8\text{m})\approx 1.7e0$	0
16		Elon Musk's net worth today in Díaz? A: $\$250e9/\$3.75e6\approx 7e4\approx 1e5$	5
17		Market cap of GM in Díaz? A: $\$50e9/\$3.75e6\approx 1.3e4$	4
18		How much is a US penny worth in Díaz? A: $\$1e-2/\$3.75e6\approx 2.7e-9$	-9
19		What is the kinetic energy of a Cheetah at maximum speed in Díaz units of energy? A: $\frac{1}{2}(60\text{kg})(35\text{m}/\text{s})^2/9e6\approx 4e-3$	-3
20		What is the gravitational force of Mr. Díaz on Jupiter in Díaz unit of force? A: Jupiter's grav accel is 2.4X that on Earth. So, force is 2.4X the force of Mr. Díaz on Earth. Answer is 2.4e0	0
21		What is the potential energy of Mr. Díaz on top of Everest with reference to the sea level in Díaz unit of energy? A: Height of Everest is 8848m. Potential Energy= $90\text{kg}(9.81\text{m}/\text{s}^2)(8848\text{m})/(9e6\text{J})\approx 0.8\approx 1e0$	0
22		How may Díaz of pressure will the water pressure halfway to the bottom of the Mariana's trench be? A: Trench is 11.5e3m. Pressure= $\frac{1}{2}\rho gh=\frac{1}{2}(1000\text{Kg}/\text{m}^3)(9.81\text{m}/\text{s}^2)(11.5e3\text{m})/(22e3\text{Pa})\approx 2.6e3$	3
23		When Mr. Díaz fills his car tires with air, how many Díaz of pressure will he fill his car tires to? A: $35\text{psi}\cdot (6895\text{pa}/\text{psi})/(22e3\text{Pa})\approx 11\approx 1e1$	1
24		How fast does Mr. Díaz' hair grow in Díaz unit of speed? A: $(15\text{cm}/\text{year})=(0.15\text{m}/\text{year})(1\text{year}/3e7\text{s})/(2.5\text{m}/\text{s})\approx 2e-9$	-9

25		What is the Niagara Falls average flow rate in <b>Díaz</b> unit of volumetric flow rate? A: $(2,800\text{m}^3/2)/(8.5\text{e}-5\text{m}^3/\text{s})\approx 3.3\text{e}7$	7
26		What is the ideal refrigerator temperature in <b>°Díaz</b> ? A: $(4.4^\circ\text{C}+273)/310\approx 8.95\text{e}-1\approx 1\text{e}0$	0
27		What is the average room temperature in <b>°Díaz</b> ? A: $(23^\circ\text{C}+273)/310\approx 9.55\text{e}-1\approx 1\text{e}0$	0
28		What is the boiling temperature of water in <b>°Díaz</b> ? A: $(100^\circ\text{C}+273)/310\approx 1.2\text{e}0$	0
29		What is the melting temperature of steel in <b>°Díaz</b> ? A: $(1370^\circ\text{C}+273)/310\approx 5.3\text{e}0\approx 1\text{e}1$	1
30		How much time in <b>Díaz</b> will it take Mr. Díaz to hike all of the Appalachian trail assuming no rest stops and no loss of performance? A: $(3.5\text{e}6\text{m})/(1.3\text{m}/\text{s})/(1.5\text{e}9\text{s})\approx 1.7\text{e}-3$	-3
31		How much time in <b>Díaz</b> did Mr. Díaz give you to finish this test? A: $(50\text{min})\cdot(60\text{s}/\text{min})/(1.5\text{e}9\text{s})\approx 2\text{e}-6$	-6
32		What is the surface area of Michigan in <b>Díaz</b> <sup>2</sup> ? A: $(96\text{e}3\text{mi}^2)(1.6\text{e}3\text{m}/\text{mi})^2/(1.8\text{m})^2\approx 7.6\text{e}10\approx 1\text{e}11$	11
33		What is the population density of Michigan in <b>people per Díaz</b> ? A: From previous question: Area=7.6e10Díaz <sup>2</sup> . Michigan population = 10million. Hence: $(10\text{e}6)/(7.6\text{e}10)\approx 1.3\text{e}-4$	-4
34		What is the density of water in <b>Díaz unit of mass per Díaz unit of volume</b> ? A: Since Díaz unit of mass per Díaz unit of volume is the density of Mr. Díaz and Mr. Díaz is almost all water, then density of water / density of Mr. Díaz $\approx 1\text{e}0$	0
35		If Mr. Díaz jumps from the highest point of this building where you're taking this exam onto a contraption that transfers all of his potential energy without losses as kinetic energy to launch a baseball into the air, what is the magnitude of the initial velocity of the baseball in <b>Díaz</b> when launched? A: $m_1gh=\frac{1}{2}m_2v^2$ . Hence, $v=v(2m_1gh/m_2)$ with $m_1=90\text{kg}$ , $m_2=0.144\text{kg}$ , $g=9.81\text{m}/\text{s}^2$ , $h=10\text{m}$ . $v=v[2(90\text{kg})(9.81\text{m}/\text{s}^2)(10\text{m})/(0.144\text{kg})] / (2.5\text{m}/\text{s}) \approx 1.4\text{e}2$	2
36		If Mr. Díaz shoots a target with his 9mm Glock, what is the exit speed of that bullet in <b>Díaz</b> ? A: $(335\text{m}/\text{s})/(2.5\text{m}/\text{s}) \approx 1.3\text{e}2 \leftarrow$ (this speed in Díaz will be used in <b>question 38</b> )	2
37		What is the kinetic energy of that bullet in <b>Díaz</b> units of energy? A: mass of 9mm bullet $\approx 9$ grams. $\text{K.E.}=\frac{1}{2}mv^2=\frac{1}{2}(9\text{e}-3\text{kg})(335\text{m}/\text{s})^2/9\text{e}6\text{J} \approx 6\text{e}-5 \approx 1\text{e}-4$	-4
38		The target is a large watermelon covered with a high tech Kevlar coating of negligible weight that prevents the watermelon from getting pierced by the bullet but contains the bullet upon impact. Using conservation of momentum, what is the speed in <b>Díaz</b> of the watermelon with the bullet after the impact? A: $(1.3\text{e}2)\cdot(9\text{e}-3\text{kg})/(20\text{kg}) \approx 6\text{e}-2 \approx 1\text{e}-1$	-1
39		What is <b>TWICE</b> the angular speed of a passenger car's engine at idle in <b>Díaz</b> units of angular speed? A: RPM to rad/s multiply by $\pi/30$ . Idle is 600-1200RPM. Twice is 1200-2400RPM. Hence: $1200\cdot\pi/30/(2\text{e}-7)\approx 6\text{e}8\approx 1\text{e}9$	9
40		Sound intensity, can be measured in deciBells or Watts per m <sup>2</sup> . For Mr. Díaz' eardrum, what is the sound pressure threshold of <b>pain</b> in <b>Díaz units of power per Díaz</b> ? $I=10^{(120\text{dB}/10 - 12)}$ ; $120\text{dB}=(1\text{W}/\text{m}^2)/(100\text{W}/(1.8\text{m})^2)\approx 3.2\text{e}-2$	-2
41	$\sum_{k=0}^{2024} k^2$	$\sum_{k=0}^{2004} k^2 = \frac{2024(2025)(2 \cdot 2024 + 1)}{6} \approx \frac{(2\text{e}3)(2\text{e}3)(4\text{e}3)}{6} \approx 2.7\text{e}9 \approx 2.7\text{e}15 \text{ microDíaz}$	15
42	$\sum_{k=0}^{2024} 2^k$	$\sum_{k=0}^{2024} 2^k = 2^{2025} - 1 \approx 2^{2025}; \quad \log_{10}(2^{2025}) = 2025\log_{10}2 \approx 2025 \cdot 0.301 \approx 609.525. \quad \text{F.A.} = 609 \text{ because } 0.5 < 0.699$	609
43		What is the total number of <b>diagonals</b> on a regular polygon with 2024 sides? A: $\frac{1}{2}(2024)(2021)\approx(1\text{e}3)(2\text{e}3)\approx 2\text{e}6$	6
44		In how many possible <b>ways</b> can you arrange a standard deck of playing cards? A: 52! Using Stirling approximation in $\log_{10}$ : F.A.(n!) $\approx 0.4+(n+\frac{1}{2})\log_{10}(n)-n\log_{10}(e)$ ; F.A.(52!)=F.A.(50!)+ $\log_{10}(51\cdot 52)\approx 0.4+(50.5)(1.699)-50(0.4343)+2(1.699)\approx 67.8=68$	68
45		How many possible combinations of a 3x3x3 Rubik's cube? (in previous question, 67.8 rounds to 68 because $0.8 > 0.699$ ) A: 8 corners in 3 orientations ( $8! \cdot 3^7$ ); 12 edges in 2 orientations ( $12! \cdot 2^{11}$ ); No swapping $\frac{1}{2}$ ; Hence, $\frac{1}{2}(8! \cdot 3^7)(12! \cdot 2^{11})\approx 4.3\text{e}19$	19
46		In <b>unitless GigaDíaz</b> , what is the probability of winning the grand prize on the multi-state Powerball lottery? (Chose 5 out of 69)(1 out of 26)=[ $(69!/(5!64!))\cdot 26$ ] <sup>-1</sup> =[ $65\cdot 66\cdot 67\cdot 68\cdot 69\cdot 26/5!$ ] <sup>-1</sup> = $1/292201338\approx 3.4\text{e}-9\approx 3.4\text{e}-18$ GDíaz	-18
47		In 2017 Mr. Beast went viral counting to what number in <b>unitless MegaDíaz</b> ? A: This crazy weird dude counted from 1 to 100,000 and put it all in a video. Weird, but it worked for him. $100,000=1\text{e}5=1\text{e}-1$ MDíaz	-1
48		How many <b>subscribers</b> does Mr. Beast currently have? A: over 200million subscribers $\approx 2\text{e}8$	8