Fermi

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Contents

1 Prelude

Hmmmmm.

2 Logarithms and Exponents

Logarithms	Value	Powers	Value
$\log_{10} 2$	0.30	$10^{0.1}$	1.26
$\log_{10} 3$	0.48	$10^{0.2}$	1.58
$\log_{10} 4$	0.60	$10^{0.3}$	2.00
$\log_{10} 5$	0.70	$10^{0.4}$	2.51
$\log_{10} 6$	0.78	$10^{0.5}$	3.14
$\log_{10} 7$	0.85	$10^{0.6}$	3.98
$\log_{10} 8$	0.90	$10^{0.7}$	5.01
$\log_{10} 9$	0.95	$10^{0.8}$	6.31
		$10^{0.9}$	7.94

3 Physics Olympics

Constant	Value	Details
Planck's constant	$h = 6.63 \times 10^{-34}\,\mathrm{J\,s}$	$E = hv$
Mass of electron	$m_e = 9.11 \times 10^{-31}\,\mathrm{kg}$	
Mass of proton	$m_p = 1.67 \times 10^{-27}\,\mathrm{kg}$	
Elementary charge	$e = 1.60 \times 10^{-19}\,\mathrm{C}$	
Radius of earth	$r_{earth} = 6.38 \times 10^{6}\,\mathrm{m}$	
Mass of earth	$m_{earth} = 5.98 \times 10^{24}\,\mathrm{kg}$	
Radius of sun	$r_{sun} = \mathrm{m}$	
Mass of sun	$m_{sun} = 1.98 \times 10^{30}\,\mathrm{kg}$	
Radius of moon	$r_{moon} = 1.74 \times 10^{6}\,\mathrm{m}$	
Mass of moon	$m_{moon} = 7.35 \times 10^{22}\,\mathrm{kg}$	
Astronomical Unit	$AU = 1.50 \times 10^{11}\,\mathrm{m}$	
Distance from earth to moon	$d_{earthtomoon} = 3.84 \times 10^{6}\,\mathrm{m}$	
Seconds in a day	$s_{day} = 8.64 \times 10^{4}\,\mathrm{s}$	
Seconds in a month	$s_{month} = 2.62 \times 10^{6}\,\mathrm{s}$	
Seconds in a year	$s_{year} = 3.16 \times 10^{7}\,\mathrm{s}$	

4 Lengths

Object	Size	Order of Magnitude
Proton, Neutron	1 femtometer	10^{-15}
Uranium neucleus		$10^{-14.5}$
Gamma ray		10^{-12}
Hydrogen, Helium atom		10^{-11}
X-ray, Glucose, Alpha helix		$10^{-9.2}$
Carbon nanotube, Buckyball		10^{-9}
DNA		$10^{-8.3}$
Transistor gate		$10^{-7.6}$
Virus		$10^{-7.5}$ to $10^{-6.5}$
Ultraviolet		$10^{-7.3}$
Smallest visible thing to an optical microscope		$10^{-6.8}$
Violet light		$10^{-6.4}$
Red light		$10^{-6.0}$
Bacteria		$10^{-5.9}$
Red blood cell, White blood cell, Cell nucleus	$10^{-5.3}$	
Mist droplet		$10^{-5.0}$
Infared		$10^{-4.6}$
Smallest visible thing to the human eye		$10^{-4.1}$
Paper		$10^{-3.9}$

Amoeba	$10^{-3.6}$
LCD pixel	$10^{-3.5}$
Grain of salt	$10^{-3.3}$
Grain of rice	$10^{-2.5}$
Microwave length, Penny, Marble	$10^{-1.8}$
Oak tree, Average US house	$10^{1.0}$
Blue whale	$10^{1.2}$
Boeing 747, Redwood tree, Statue of liberty	$10^{1.5}$
Football field, International space station, Saturn V	$10^{2.0}$
Titanic	$10^{2.1}$
Great pyramid of Giza	$10^{2.2}$
Eiffel tower	$10^{2.3}$
Hoover dam	$10^{2.4}$
Vatican city	$10^{2.9}$
AM radio wave	$10^{3.3}$
Central park	$10^{3.4}$
Mount everest, Large hadron collider	$10^{3.8}$
Haley's comet	$10^{3.9}$
Depth of the mariana trench	$10^{4.1}$
Marathon, Neutron star	$10^{4.3}$
Grand canyon	$10^{5.3}$
California, Italy	$10^{5.6}$
Pluto	$10^{6.1}$
Moon, USA	$10^{6.5}$
Mercury, Asia	$10^{6.6}$
Mars	$10^{6.7}$
Earth, Venus	$10^{6.9}$
Minecraft world	$10^{6.5}$
Neptune, Uranus	$10^{7.7}$
Saturn	$10^{7.9}$
Distance from earth to moon	$10^{8.3}$
The sun	$10^{8.8}$
Distance from earth to sun	10^{11}
Distance from sun to neptune	$10^{12.5}$
Light-day	$10^{13.2}$
Light-year	$10^{15.6}$
Milky way, Andromeda	$10^{20.9}$
Observable universe	$10^{26.7}$

5 Forces

Force of	Value
Weight of human	620 N
(WARN) Jump	2000 N

6 Mass

Object	Value
Human	65 kg
Car	1500 kg
(WARN) Cruise ship	30×10^6 kg to 220×10^6 kg
Empire state building	330×10^6 kg
Ounce	23.85 g
iPod touch	0.086 kg
iPod nano	0.031 kg
iPod shuffle	0.0125 kg
iPod classic	0.140 kg
iPhone 5s	0.112 kg
iPad Air	0.475 kg
iPad 2	0.600 kg
iPad mini	0.330 kg
Macbook air	1.35 kg
Macbook pro (15 inch)	2.02 kg
Mac mini	1.22 kg
Mac (21.5 inch)	5.68 kg
Mac (27 inch)	9.54 kg
(WARN) Mac pro	5 kg

7 Time

Hmmmmm.

8 Energy

8.1 General Facts

- 1 kW h = 3.6×10^6 J
- 1 W year = 8.74 kW h
- Average cost: 14 cents per kilowatt-hour
- Average home usage per year: 11 280 kW h
- Average home usage per month: 950 kW h
- Average home usage per day: 31 kW h

8.2 Electronics

- iPhone battery: 1570 mA h at 3.7 V (5.92 W h)
- iPhone power consumption (idle – 250 hours): 23.7 mW
- iPhone power consumption (talk/internet/video – 10 hours): 592 mW
- iPhone power consumption (audio – 40 hours): 148 mW
- iPad battery: 8827 mA h (118 kJ) at 3.7 V (32.9 W h)
- iPad conversion example: 32.9 W h $\approx$ 8827 mA h $*$ 3.7 V $*$ (1 A/1000 mA)
- iPad conversion example: 118 kJ $\approx$ 32.9 W h $*$ (3600 s/1 h) $*$ (1 kJ/1000 J)
- (WARN) Voltage in a mobile phone circuit: 0.5 V to 1 V
- (WARN) Current in a mobile phone circuit: 100 mA to 180 mA

Appliance	Power Consumption
Light bulb	2 W to 120 W
Desktop	250 W to 720 W
Laptop	250 W
(WARN) Coffee maker	800 W
(WARN) Microwave	600 W to 1500 W
(WARN) Dishwasher	1200 W to 1500 W
(WARN) Washing machine	300 W to 500 W
(WARN) Iron	1000 W
(WARN) Air conditioner	2000 W to 5000 W
(WARN) Ceiling fan	10 W to 50 W
(WARN) TV	150 W
(WARN) Oven	3000 W

9 Electromagnetic Spectrum

Type	Wavelength	Frequency	Energy	Reference
Radio	1×10^{3} m	1×10^{4} Hz		
Microwave	1×10^{-2} m	1×10^{10} Hz		
Infared	1×10^{-5} m	1×10^{13} Hz		
Visible	5×10^{-7} m	1×10^{15} Hz		
Ultraviolet	1×10^{-8} m	1×10^{16} Hz		
X-ray	1×10^{-10} m	1×10^{18} Hz		
Gamma	1×10^{-12} m	1×10^{20} Hz		

Colour	Wavelength		Frequency	Energy	Reference
Violet	380×10^{-9} m	to	668×10^{12} Hz	to	
	450×10^{-9} m		789×10^{12} Hz		
Blue	450×10^{-9} m	to	606×10^{12} Hz	to	
	495×10^{-9} m		668×10^{12} Hz		
Green	495×10^{-9} m	to	526×10^{12} Hz	to	
	570×10^{-9} m		606×10^{12} Hz		
Yellow	570×10^{-9} m	to	508×10^{12} Hz	to	
	590×10^{-9} m		526×10^{12} Hz		
Orange	590×10^{-9} m	to	484×10^{12} Hz	to	
	620×10^{-9} m		508×10^{12} Hz		
Red	620×10^{-9} m	to	400×10^{12} Hz	to	
	750×10^{-9} m		484×10^{12} Hz		

9.1 Other Facts

- Wifi: 2.4 GHz to 5 GHz
- Cellular frequencies: 900 MHz in Europe and Asia; 1900 MHz in the USA

10 Demographics

Location	Population	Known For
Canada	35.16 million	
USA	313.9 million	
Europe	739.2 million	
China	1.36 billion	
India	1.24 billion	
Indonesia	238 million	
Brazil	201 million	
Russia	144 million	

Japan	127 million
Mexico	118 million
Vietnam	90.4 million
Germany	80.5 million
France	65.8 million
Great Britain	63.7 million
Italy	59.9 million
South Africa	53.0 million
South Korea	50.2 million
Spain	46.7 million
Kenya	44.3 million
Argentina	40.1 million
Poland	38.5 million
Malaysia	29.9 million
Taiwan	23.4 million
Australia	23.3 million
Netherlands	16.8 million
Belgium	11.2 million
Greece	10.8 million
Portugal	10.6 million
Czech Republic	10.5 million
Sweden	9.63 million
Austria	8.50 million
UAE	8.26 million
Israel	8.09 million
Hong Kong	7.18 million
Denmark	5.62 million
Singapore	5.40 million
Scotland	5.30 million
Ireland	4.59 million

10.1 Todo

- population density
- population history
- cities, provinces, states

11 Geography

Location	Area	Width	Diagonal	Height
Canada	$9.98 \times 10^6\,\mathrm{km}^2$	4800 km (3000 miles)		
USA	$9.83 \times 10^6\,\mathrm{km}^2$	4180 km	4500 km (2800 miles)	
Russia	$17.1 \times 10^6\,\mathrm{km}^2$			
China	$9.71 \times 10^6\,\mathrm{km}^2$			
France	$675 \times 10^3\,\mathrm{km}^2$			
Spain	$503 \times 10^3\,\mathrm{km}^2$			
Japan	$378 \times 10^3\,\mathrm{km}^2$			
Germany	$357 \times 10^3\,\mathrm{km}^2$			
UK	$224 \times 10^3\,\mathrm{km}^2$			

11.1 Todo

- cities, provinces, states

12 Technology

- Apple A7 chip: over 1 billion transistors on 102 $102\,\mathrm{mm}^2$ die

13 Economy

13.1 Canada

Hmmmmm.

13.2 China

Hmmmmm.

13.3 Europe

Hmmmmm.

13.4 Russia

Hmmmmm.

13.5 India

Hmmmmm.

13.6 USA

- GDP in one quarter: $16.66 trillion
- GDP per capita: $49 601
- Population below poverty line: 14.8%
- Labour force: 155.6 million
- Unemployed: 11.26 million
- Unemployment: 7.2%
- Average gross salary: $45 790
- Farming, forestry, fishing: 0.7%
- Manufacturing, extraction, transportation, crafts: 20%
- Managerial, professional, technical: 37%
- Sales, office: 24%
- Other: 18%
- Exports: $1.56 trillion
- Capital goods: 28%
- Industrial supplies and materials (excluding oil fuels): 25%
- Consumer goods (except automotive): 12%
- Automobiles and components: 9.4%
- Food and beverages: 8.6%
- Fuel oil, petroleum products: 7.6%
- Aircraft and components: 6%
- Other: 4%
- Export to Canada: 19%
- Export to Mexico: 14%

- Export to China: 7%
- Export to Japan: 4.5%
- Imports: $2.3 trillion
- Consumer goods (except automotive): 23%
- Capital goods (Except computing): 19%
- Industrial supplies (except crude oil): 18%
- Crude oil: 14%
- Automobiles and components: 13%
- Computers and accessories: 5.4%
- Food and beverages: 4.8%
- Other: 3%
- Import from China: 19%
- Import from Canada: 14%
- Import from Mexico: 12%
- Import from Japan: 6.4%
- Import from Germany: 4.7%
- Public debt: $17.091 trillion (107.2% of GDP)
- Budget deficit: $680 billion
- Revenues: $2.774 trillion
- Individual income tax: 46%
- Social insurance: 35%
- Corporate tax: 24%
- Other: 9.3%
- Expenses: $3.454 trillion
- Social security: 22%
- Defense: 18%
- Medicare: 13%
- Interest: 7.3%
- Medicaid: 7.1%
- Other: 32%

14 Animals

Hmmmmm.

15 Plants

Hmmmmm.

16 Biology

Hmmmmm.

17 Architecture

Hmmmmm.

18 Related rates

Hmmmmm.

19 Chemical properties

Hmmmmm.

20 History

Period	Begin	End
Ancient Greek (archaic)	900 BC	500 BC
Ancient Greek (classical)	500 BC	300 BC
Ancient Greek (hellenistic)	300 BC	600 AD
Roman empire (west)	27 BC	476 AD
Roman empire (east)	330	1453
Middle ages/Medieval period	400	1400
Renaissance	1300	1600
Industrial revolution	1760	1830
Baroque period	1590	1725
Classical period	1730	1820
Romantic period	1815	1910
WWI	1914	1918
WWII	1939	1945
Great Depression	1929	Late 1930s, Mid 1940s

Person	Birth	Death	Description
Socrates	469 BC	399 BC	
Aristotle	384 BC	322 BC	
Julius Caesar (roman emperor)	100 BC	44 BC	
Augustus (roman emperor)	63 BC	14 AD	
Nero (roman emperor)	37	68	
Constantine I (roman emperor)	272	337	
Charlemange	740s	814	
Martin Luther	1483	1546	
Queen Elizabeth I	1533	1603	
James Watt	1736	1819	
Isaac Newton	1642	1727	
Gottfried Wilhelm Leibniz	1646	1716	
Albert Einstein	1879	1955	
Carl Friedrich Gauss	1777	1855	
Leonhard Euler	1707	1783	
Pythagoras	570 BC	495 BC	
Pierre de Fermat	1601	1665	
Blaise Pascal	1623	1662	
John Milton	1608	1674	
Shakespeare	1564	1616	
John Donne	1572	1631	
Robert Burns	1759	1796	
William Butler Yeats	1865 - 1939		
J.R.R. Tolkien	1892	1973	
Martin Luther King Jr.	1929	1968	
Captain George Vancouver	1757	1798	
Linus Torvalds	1969	na	
Steve Jobs	1955	2011	
Bill Gates	1955	na	
Larry Page	1973	na	
Sergey Brin	1973	na	
Eric Schmidt	1955	na	
James Gosling	1955	na	
Dennis Ritchie	1941	2011	
Ken Thompson	1943	na	
Bjarne Stroustrup	1950	na	
Guido van Rossum	1956	na	
Yukihiro Matsumoto	1965	na	

Event	Date	Description
Martin Luther nails Ninety-Five Theses	1517 October 31	

21 Literature

Work	Date	Author
Beowulf	975 - 1025	Unknown
Hamlet	1599 - 1602	Shakespeare
King Lear	1603 - 1606	Shakespeare
Macbeth	1603 - 1607	Shakespeare
To a Mouse	1785	Robert Burns
Paradise Lost	1667	Milton
The Second Coming	1919	Yeats
Lord of the Rings	1954 - 1955	Tolkien

22 Music

Piece	Date	Composer
Symphony 5	1804 - 1808	Beethoven
The Well Tempered Clavier	1722	Bach
Symphony 9	1824	Beethoven
Eine kleine Nachtmusik	1787	Mozart