Conversion Factors (more conversion factors in Appendix C)

Length

1 in = 2.54 cm
1 mi = 1.609 km
1 ft = 0.3048 m
1 light year = 9.46×10^{15} m

Velocity

1 mi/h = 0.447 m/s
1 m/s = 2.24 mi/h = 3.28 ft/s

Mass, energy, force

1 u = 1.661×10^{-27} kg
1 cal = 4.184 J
1 Btu = 1.054 kJ
1 kWh = 3.6 MJ
1 eV = 1.602×10^{-19} J
1 pound (lb) = 4.448 N
= weight of 0.454 kg

Time

1 day = 86,400 s
1 year = 3.156×10^{7} s

Pressure

1 atm = 101.3 kPa = 760 mm Hg
1 atm = 14.7 lb/in^2

Rotation and angle

1 rad = $180°/\pi = 57.3°$
1 rev = $360° = 2\pi$ rad
1 rev/s = 60 rpm

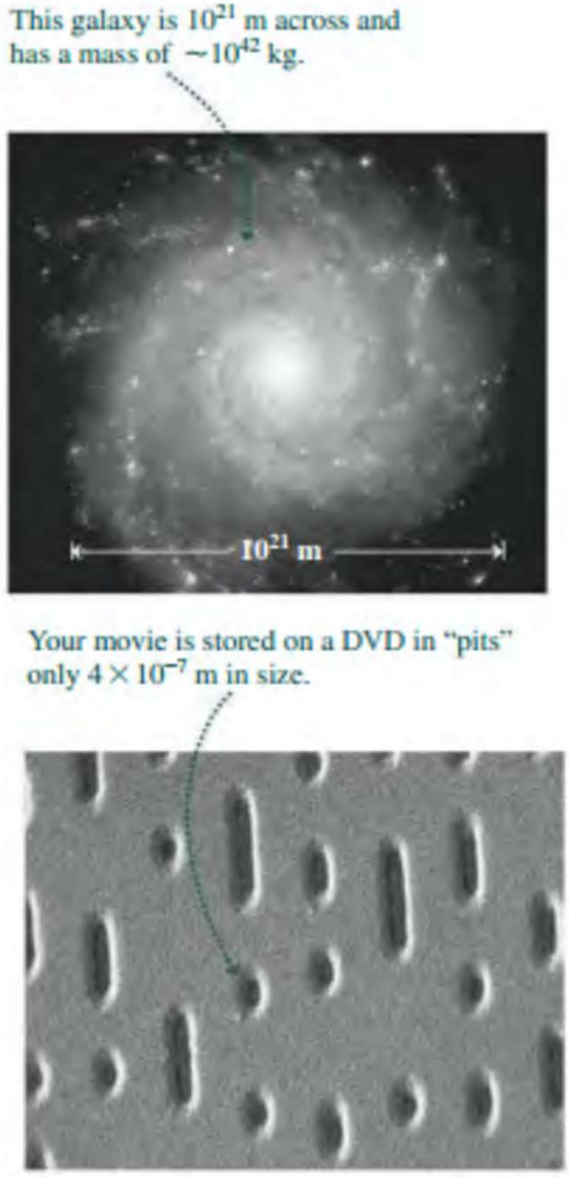
Magnetic field

1 gauss = 10^{-4} T

1.2 Measurements and Units

Table 1.2 Distances, Times, and Masses (rounded to one significant figure)

Radius of observable universe	1×10^{26} m
Earth's radius	6×10^{6} m
Tallest mountain	9×10^{3} m
Height of person	2 m
Diameter of red blood cell	1×10^{-5} m
Size of proton	1×10^{-15} m
Age of universe	4×10^{17} s
Earth's orbital period (1 year)	3×10^{7} s
Human heartbeat	1 s
Wave period, microwave oven	5×10^{-10} s
Time for light to cross a proton	3×10^{-24} s
Mass of Milky Way galaxy	1×10^{42} kg
Mass of mountain	1×10^{18} kg
Mass of human	70 kg
Mass of red blood cell	1×10^{-13} kg
Mass of uranium atom	4×10^{-25} kg
Mass of electron	1×10^{-30} kg



PHYSICAL CONSTANTS

CONSTANT	SYMBOL	THREE-FIGURE VALUE	BEST KNOWN VALUE*
Speed of light	c	3.00×10^{8} m/s	299,792,458 m/s (exact)
Elementary charge	e	1.60×10^{-19} C	$1.602\,176\,634 \times 10^{-19}$ C (exact)
Electron mass	m_e	9.11×10^{-31} kg	$9.109\,383\,56(11) \times 10^{-31}$ kg
Proton mass	m_p	1.67×10^{-27} kg	$1.672\,621\,898(21) \times 10^{-27}$ kg
Gravitational constant	G	6.67×10^{-11} N·m^2/kg^2	$6.67408(31) \times 10^{-11}$ N·m^2/kg^2
Permeability constant	μ_0	1.26×10^{-6} N/A^2 (H/m)	$12.566\,370\,616\,9(29) \times 10^{-7}$ N/A^2
Permittivity constant	ϵ_0	8.85×10^{-12} C^2/N·m^2 (F/m)	$8.854\,187\,815\,8(20) \times 10^{-7}$ C^2/ N·m^2
Boltzmann's constant	k	1.38×10^{-23} J/K	$1.380\,649 \times 10^{-23}$ J/K (exact)
Universal gas constant	R	8.31 J/K·mol	$N_A k$ (exact)
Stefan–Boltzmann constant	σ	5.67×10^{-8} W/m^2·K^4	$5.670\,367(13) \times 10^{-8}$ W/m^2·K^4
Planck's constant	$h(=2\pi\hbar)$	6.63×10^{-34} J·s	$6.626\,070\,15 \times 10^{-34}$ J·s (exact)
Avogadro's number	N_A	6.02×10^{23} mol^{-1}	$6.022\,140\,76 \times 10^{23}$ mol^{-1} (exact)
Bohr radius	a_0	5.29×10^{-11} m	$5.291\,772\,085\,9(36) \times 10^{-11}$ m

Speed of light c = 3.00 x 10^8 m/s

Tactics 1.1 USING SCIENTIFIC NOTATION

Addition/Subtraction

To add (or subtract) numbers in scientific notation, first give them the same exponent and then add (or subtract):

$$3.75\times10^{6} + 5.2\times10^{5} = 3.75\times10^{6} + 0.52\times10^{6} = 4.27\times10^{6}$$

Multiplication/Division

To multiply (or divide) numbers in scientific notation, multiply (or divide) the digits and add (or subtract) the exponents:

$$(3.0\times10^{8}\,\text{m/s})(2.1\times10^{-10}\,\text{s}) = (3.0)(2.1)\times10^{8+(-10)}\,\text{m} = 6.3\times10^{-2}\,\text{m}$$

Powers/Roots

To raise numbers in scientific notation to any power, raise the digits to the given power and multiply the exponent by the power:

$$\begin{aligned}\sqrt{(3.61\times10^{4})^{3}} &= \sqrt{3.61^{3}\times10^{(4)(3)}} = (47.04\times10^{12})^{1/2} \\ &= \sqrt{47.04}\times10^{(12)(1/2)} = 6.86\times10^{6}\end{aligned}$$

Changing Units

$$(2722\ \text{ft})\left(\frac{0.3048\ \text{m}}{1\ \text{ft}}\right) = 829.7\ \text{m}$$

FIGURE 1.3 Dubai's Burj Khalifa is the world's tallest structure.

GOT IT?

1.1 A Canadian speed limit of 50 km/h is closest to which U.S. limit expressed in miles per hour? (a) 60 mi/h; (b) 45 mi/h; (c) 30 mi/h

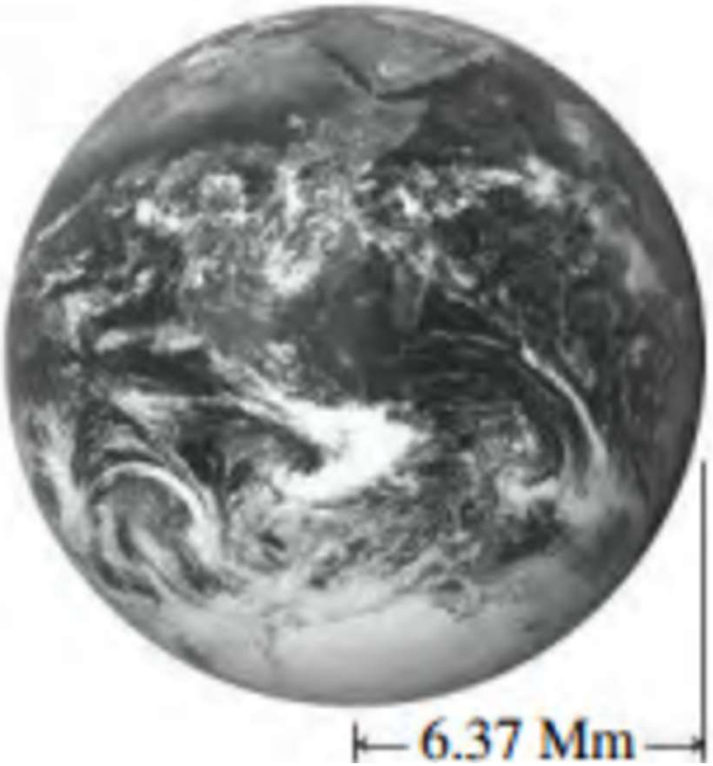
Numbers are often written with prefixes or in scientific notation to express powers of 10. Precision is shown by the number of significant figures:

Power of 10

Earth's radius 6.37×10^6 m = 6.37 Mm

Three significant figures

SI prefix for ×10



Speed of light c = 3.00×10^8 m/s

- $3.00 \times 10^2 \times 10^6$

M = 1,000,000,000 = 10^6
M = 1,000,000 = 10^6
K = 1,000 = 10^3
1,000 x 1,000 = $10^{3+3} = 10^6$
$10^{10} = 10^{1+9} = 10^{4+6} = 10^{7+3}$

10^{10} m = $10^{1+9} = 10^1 \times 10^9$ = 10 Gm
1010m = $10^{4+6} = 10^4 \times 10^6$ = 10 Mm

0.001 = 1 / 1000 = 1 / 10^3 = 10^{-3}

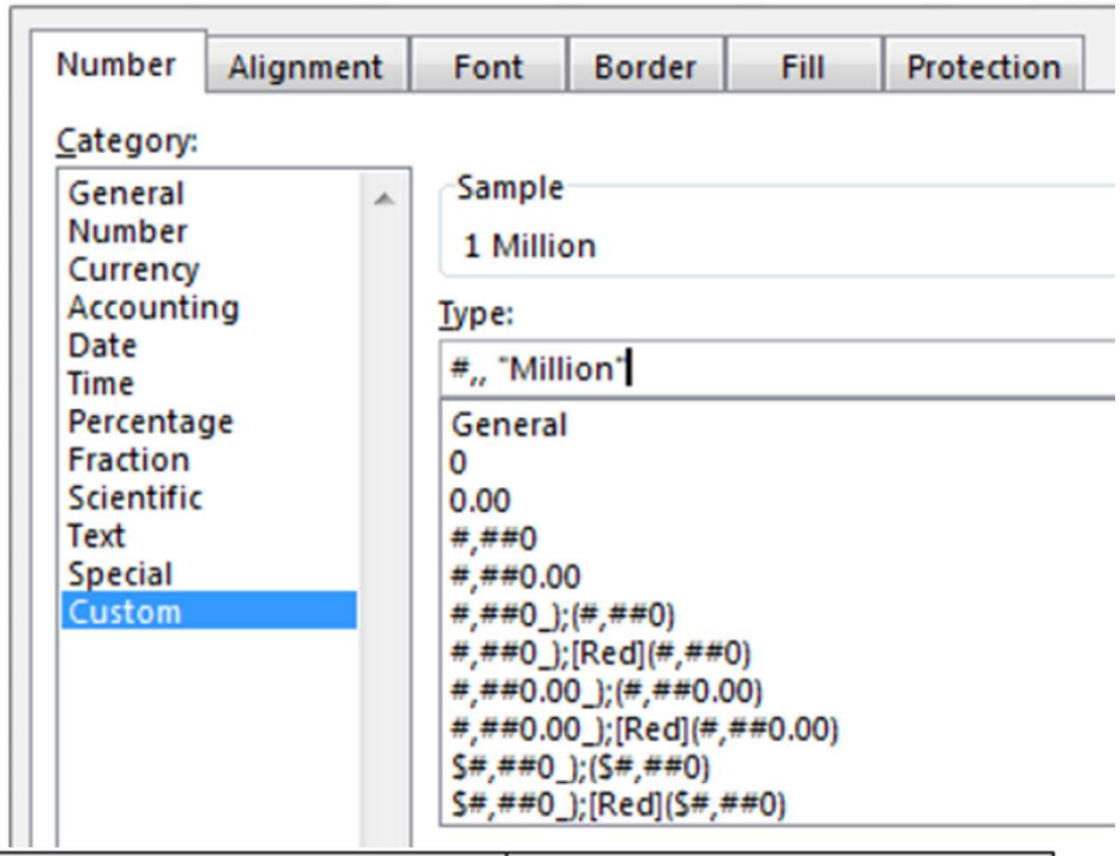
POWER	PREFIX	SYMBOL
10^{24}	yotta	Y
10^{21}	zetta	Z
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deca	da
10^{0}	—	—
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y

Unit Conversions

The following unit abbreviations can be prefixed to any metric "from unit" or "to unit" to automatically convert the units.

	A	B	C	D	E	F
1						
2		**Prefix**	**Abbreviation**	**Value**	**Multiplier**	
3		exa	E	1000000000000000000	1.00E+18	
4		peta	P	1000000000000000	1.00E+15	
5		tara	T	1000000000000	1.00E+12	
6		giga	G	1000000000	1.00E+09	
7		mega	M	1000000	1.00E+06	
8		kilo	k	1000	1.00E+03	
9		hecto	h	100	1.00E+02	
10		deka	e	10	1.00E+01	
11		deci	d	0.1	1.00E-01	
12		centi	c	0.01	1.00E-02	
13		milli	m	0.001	1.00E-03	
14		micro	u	0.000001	1.00E-06	
15		nano	n	0.000000001	1.00E-09	
16		pico	p	0.000000000001	1.00E-12	
17		femto	f	0.000000000000001	1.00E-15	
18		atto	a	0.000000000000000001	1.00E-18	
19						
20		1 mile in metres	1609.34	=CONVERT(1,"mi","m")		
21		1 mile in kilometres	1.61	=CONVERT(1,"mi","km")		
22		1 mile in centimetres	160934.40	=CONVERT(1,"mi","cm")		
23		1 mile in millimetres	1609344.00	=CONVERT(1,"mi","mm")		
24						

Format numbers in thousand: 0, "K"
Format numbers in millions: 0,,"M"
Format numbers in billions: 0,,,"B"



Display Value	Value Without Format	Format Code
12 Million	12000000	#,, “Million”
1.0 Million	1000000	#.#0,, “Million”
19 Thousand	19000	#, “Thousand”

C9 | =A9/1000 & " Thousand"

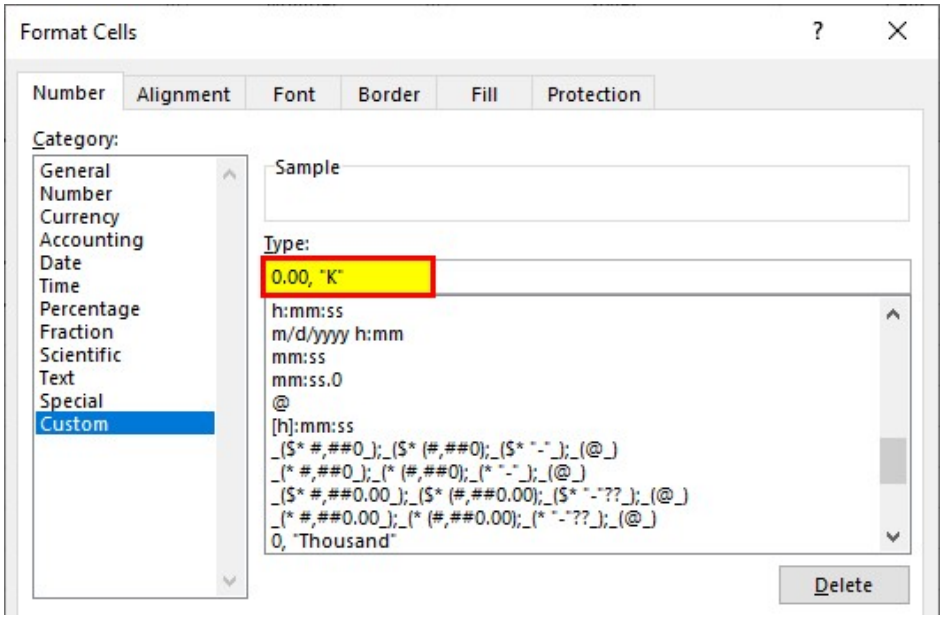
	A	B	C	D
1	Value	Format Code	Result	
2	2,500	0, "Thousands"	2.50 Thousands	
3	25,000	0, "Thousands"	25.00 Thousands	
4	250,000	0, "Thousands"	250.00 Thousands	
5	70,000	0, "Thousands"	70.00 Thousands	
6	825,000	0, "Thousands"	825.00 Thousands	
7				
8	Value	Format Code	Result	
9	2,500	0, "Thousands"	2.5 Thousand	
10	25,000	0, "Thousands"	25 Thousand	
11	250,000	0, "Thousands"	250 Thousand	
12	70,000	0, "Thousands"	70 Thousand	
13	825,000	0, "Thousands"	825 Thousand	
14				

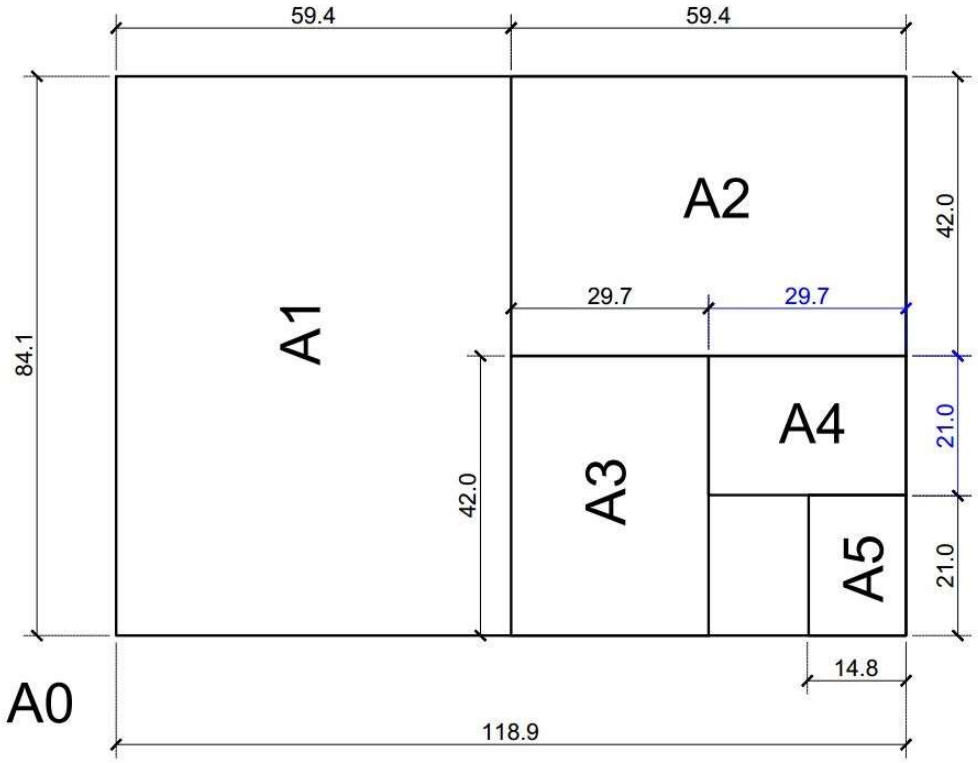
C17 | 2500

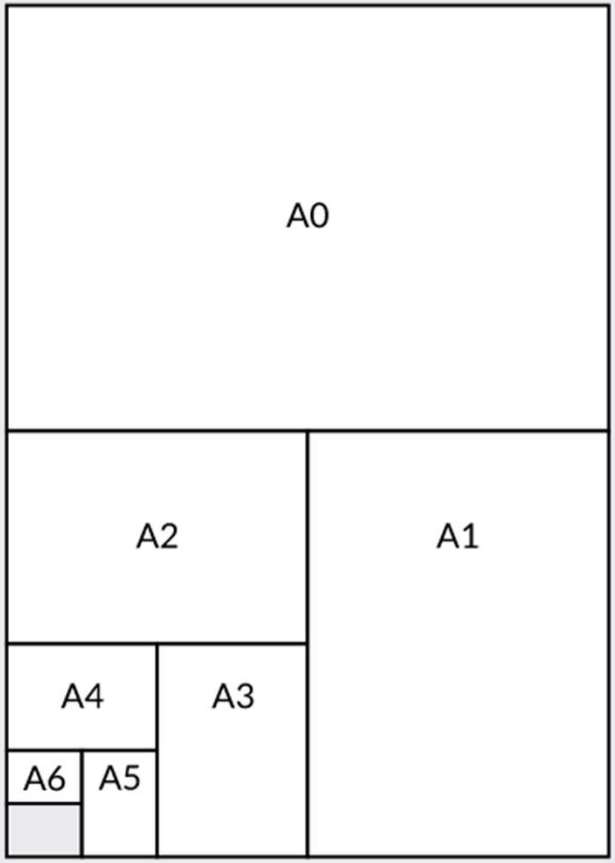
	A	B	C	D
16	Value	Format Code	Result	
17	2,500	0.0, "K"	2.50 K	
18	25,000	0.0, "K"	25.00 K	
19	250,000	0.0, "K"	250.00 K	
20	70,000	0.0, "K"	70.00 K	
21	825,000	0.0, "K"	825.00 K	
22				

	A
1	Numbers
2	2543560000
3	8551200
4	9016010000
5	12889056
6	3778213400
7	1056340
8	34125543290
9	56780
10	27889034

	A
1	Numbers
2	2.5 B
3	8.6 M
4	9.0 B
5	12.9 M
6	3.8 B
7	1.1 M
8	34.1 B
9	56.8 K
10	27.9 M





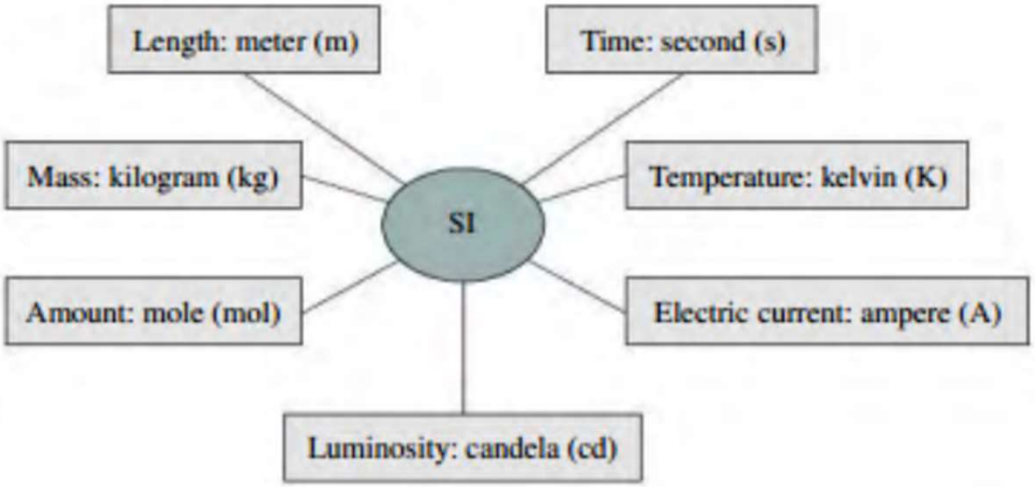


4A0	1682 x 2378mm
2A0	1189 x 1682mm
A0	841 x 1189mm
A1	594 x 840mm
A2	420 x 594mm
A3	297 x 420mm
A4	210 x 297mm
A5	148 x 210mm
A6	105 x 148mm
A7	74 x 105mm
A8	52 x 74mm
A9	37 x 52mm
A10	26 x 37mm

Key Concepts and Equations

Numbers describing physical quantities must have units. The SI unit system comprises seven fundamental units:

In addition, physics uses geometric measures of angle.



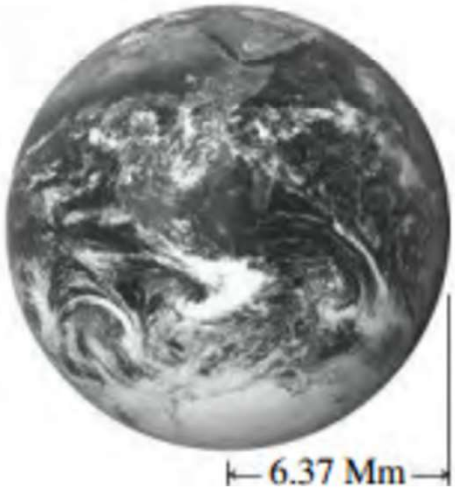
Numbers are often written with prefixes or in scientific notation to express powers of 10. Precision is shown by the number of significant figures:

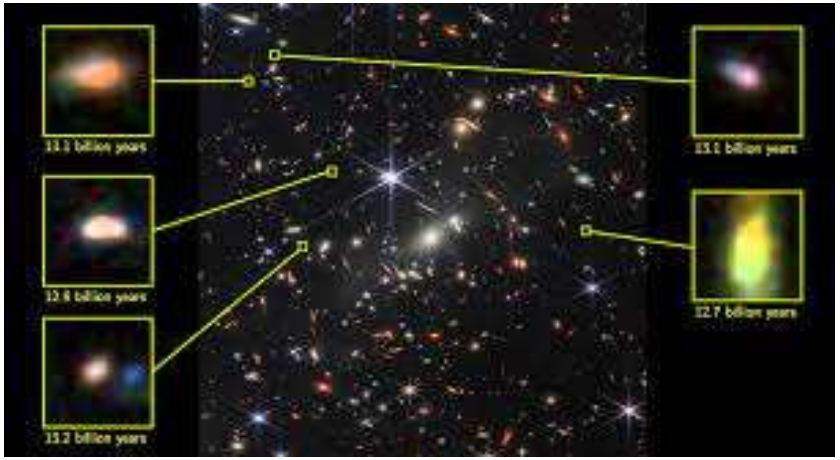
Power of 10

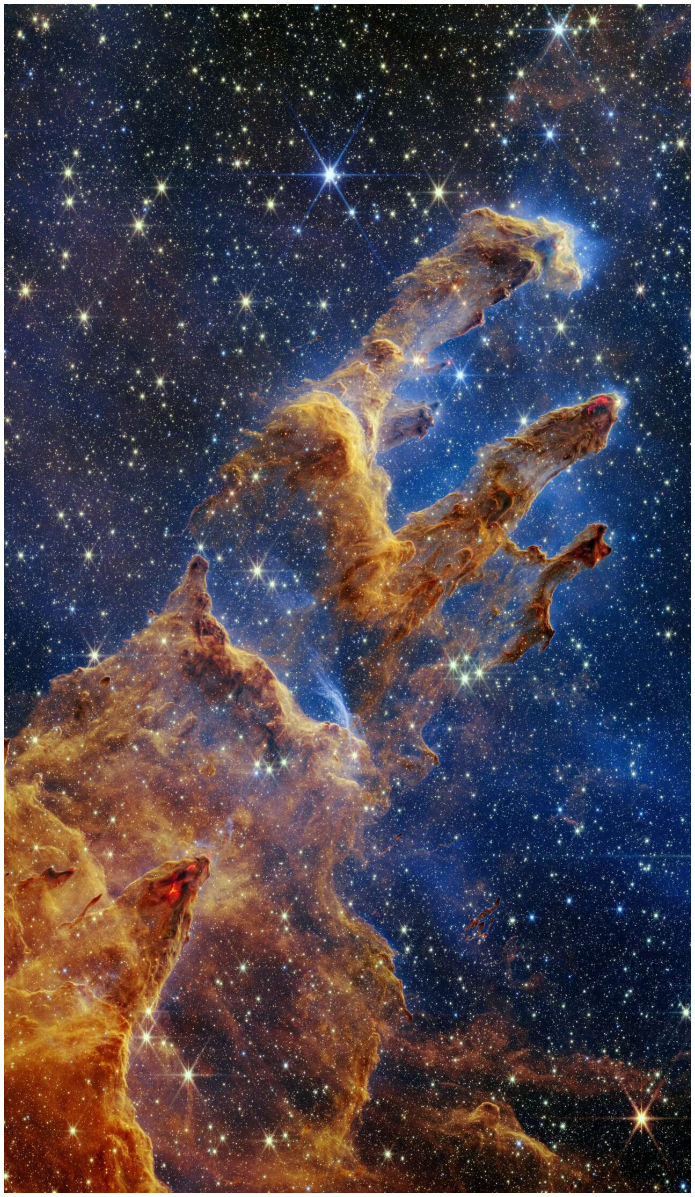
Earth's radius 6.37×10^6 m = 6.37 Mm

Three significant figures

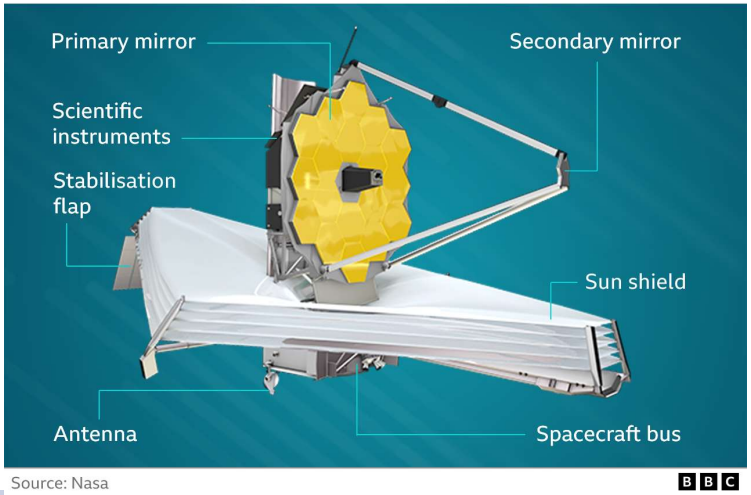
SI prefix for $\times 10^6$



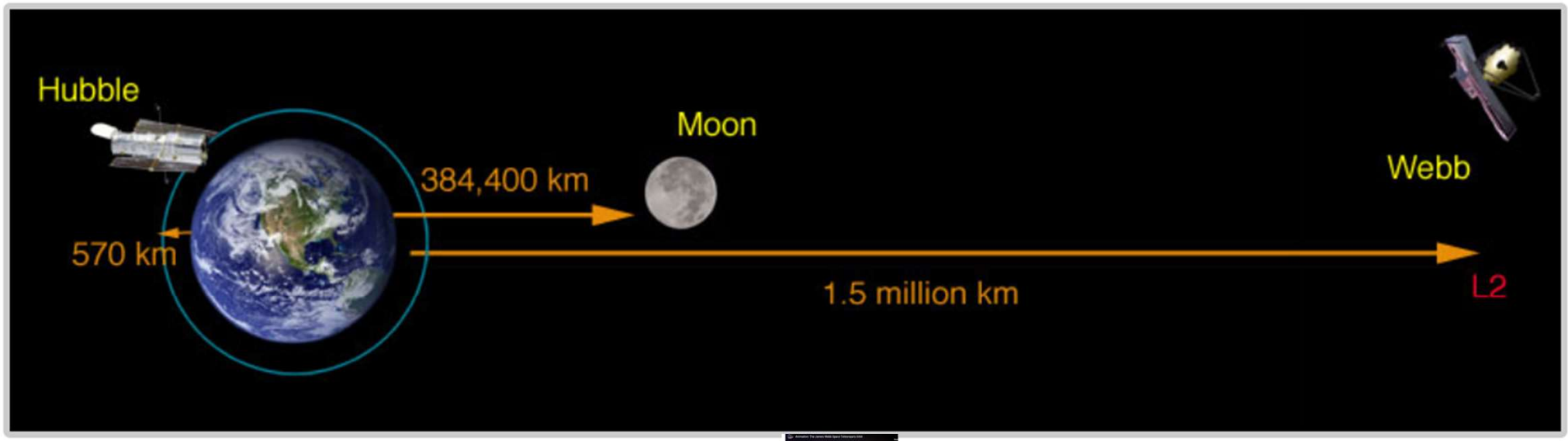

13.1 billion years
13.1 billion years
12.8 billion years
12.7 billion years
13.2 billion years

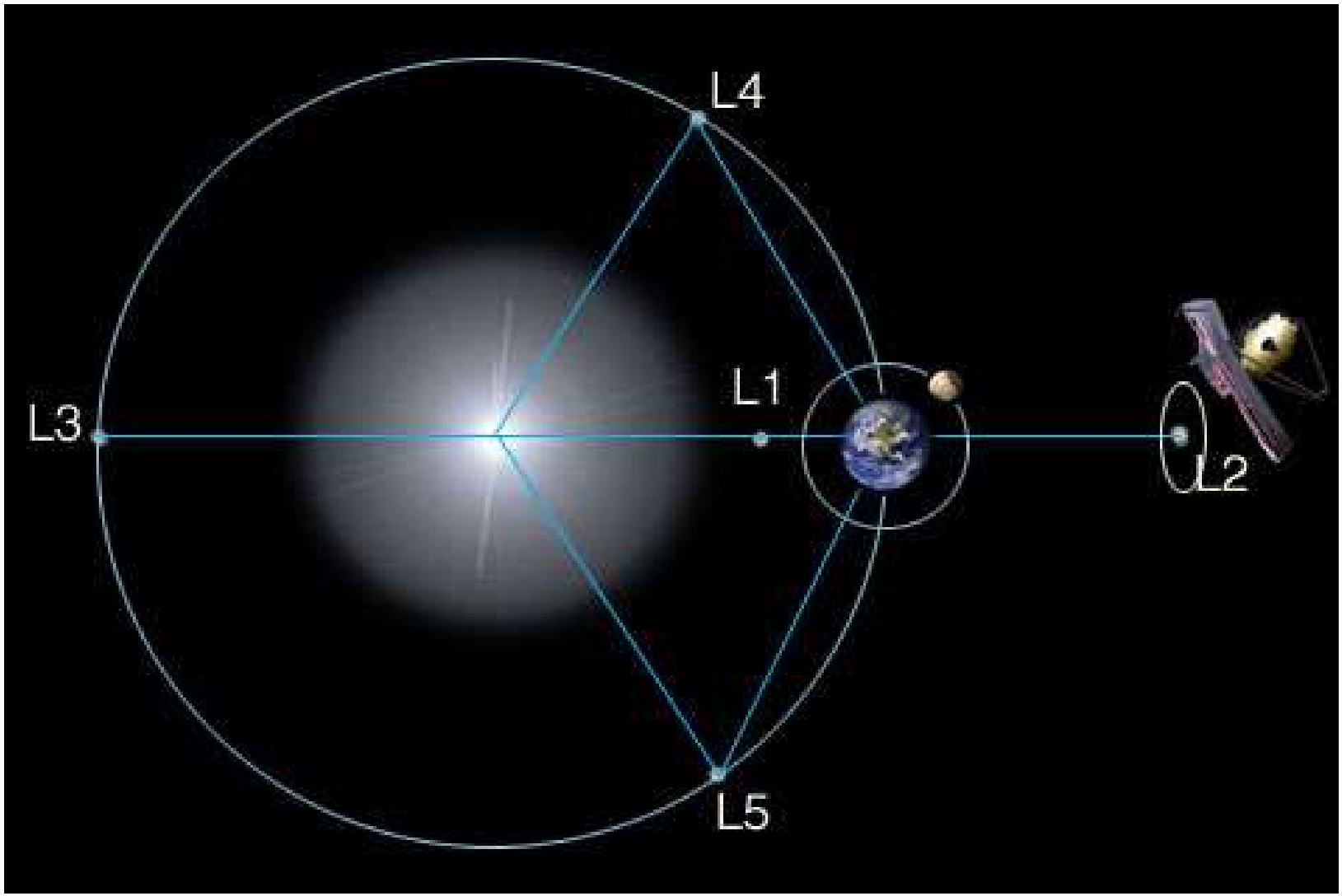


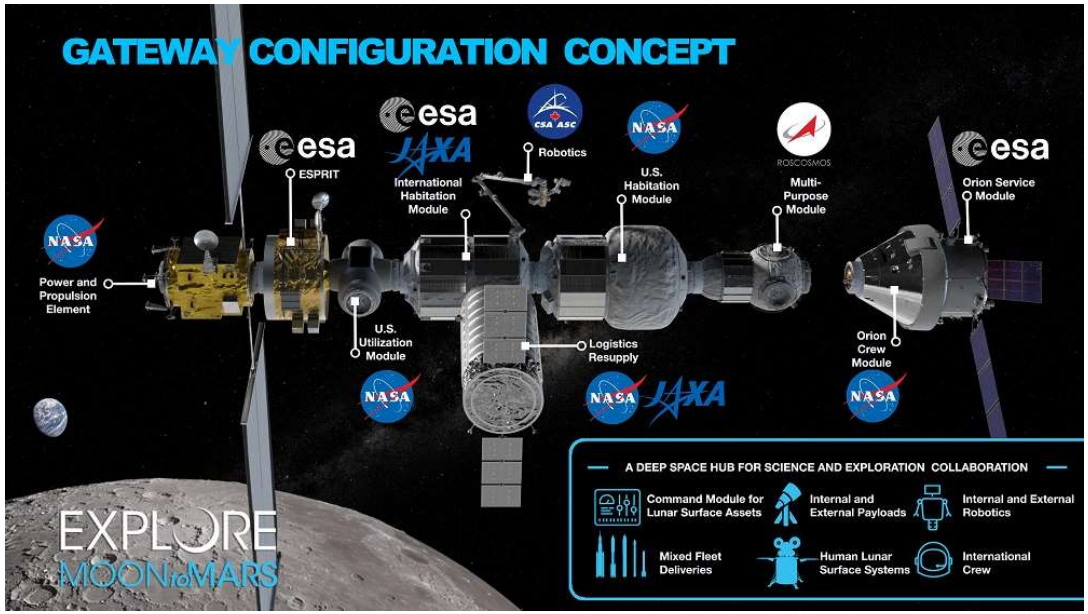
กล้องโทรทรรศน์อวกาศ James Webb Space Telescope

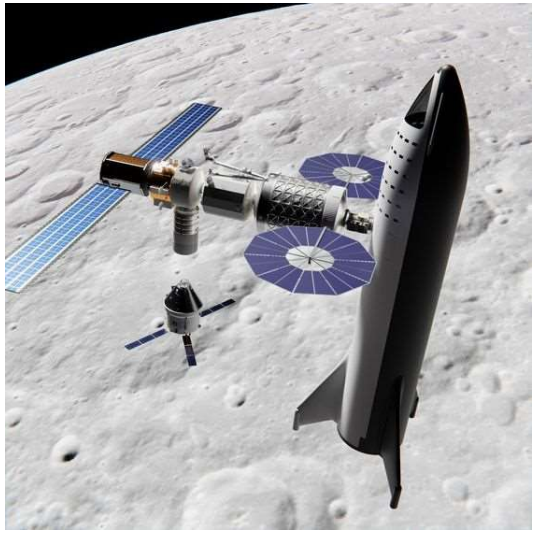


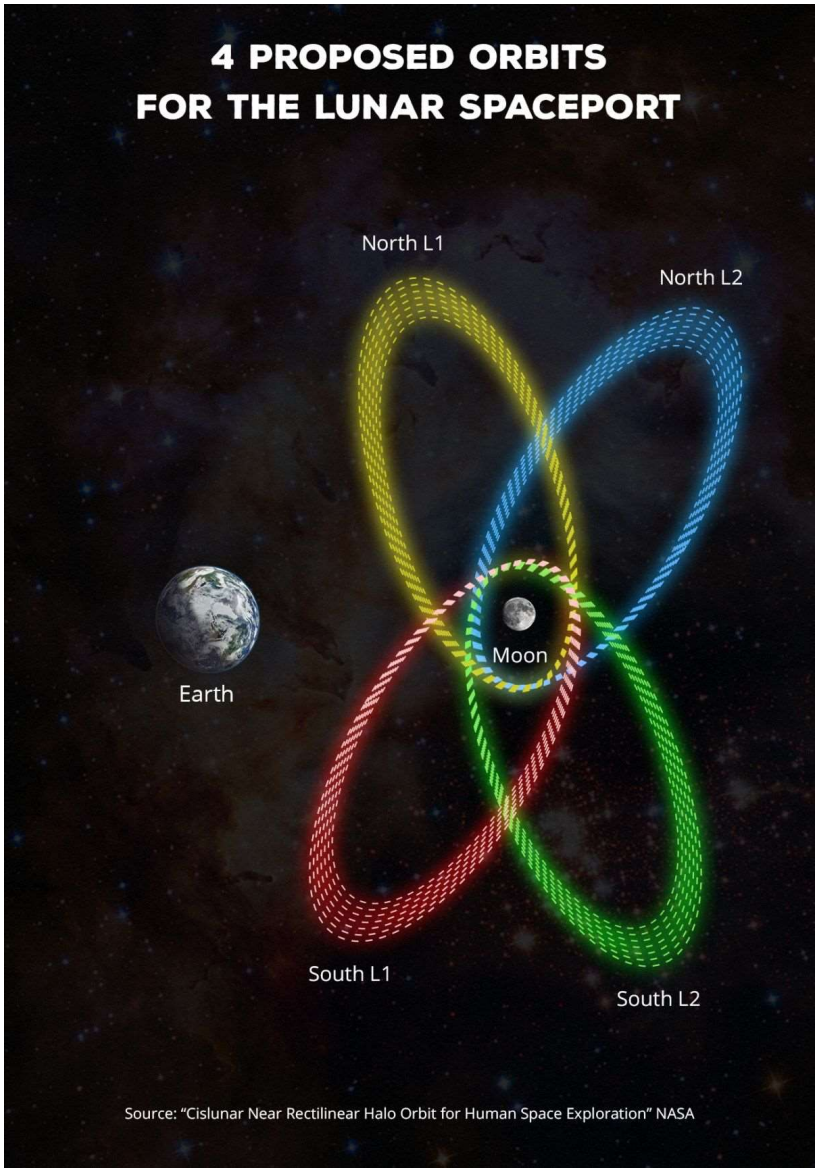

The Sun
Mercury
Venus
Earth
150 million km

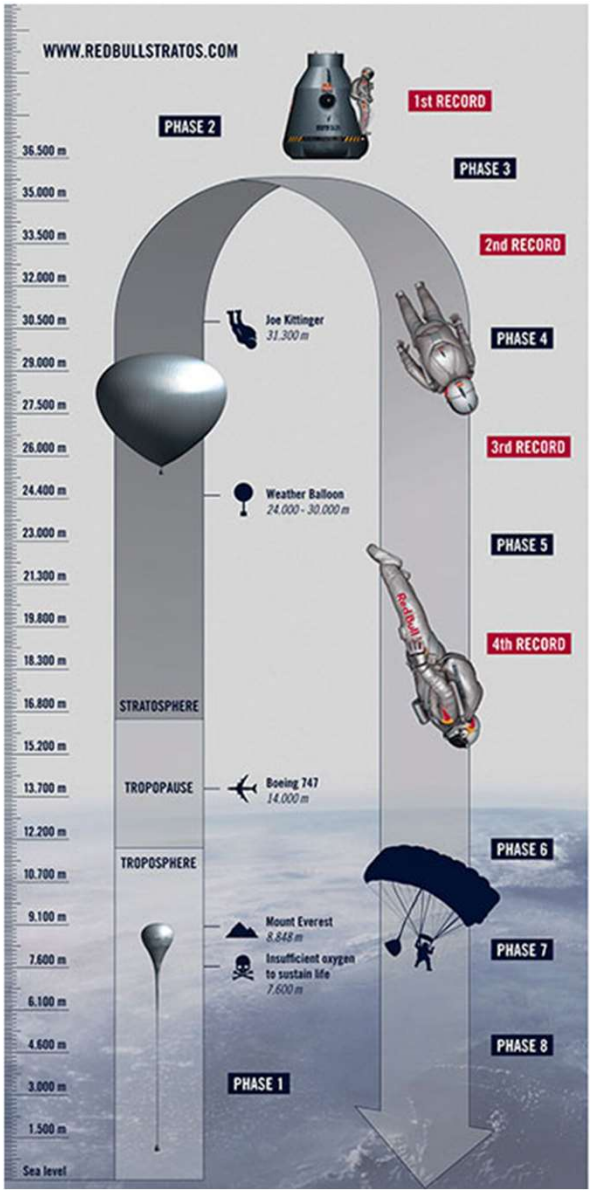

Hubble
570 km
384,400 km
Moon
Webb
1.5 million km
L2

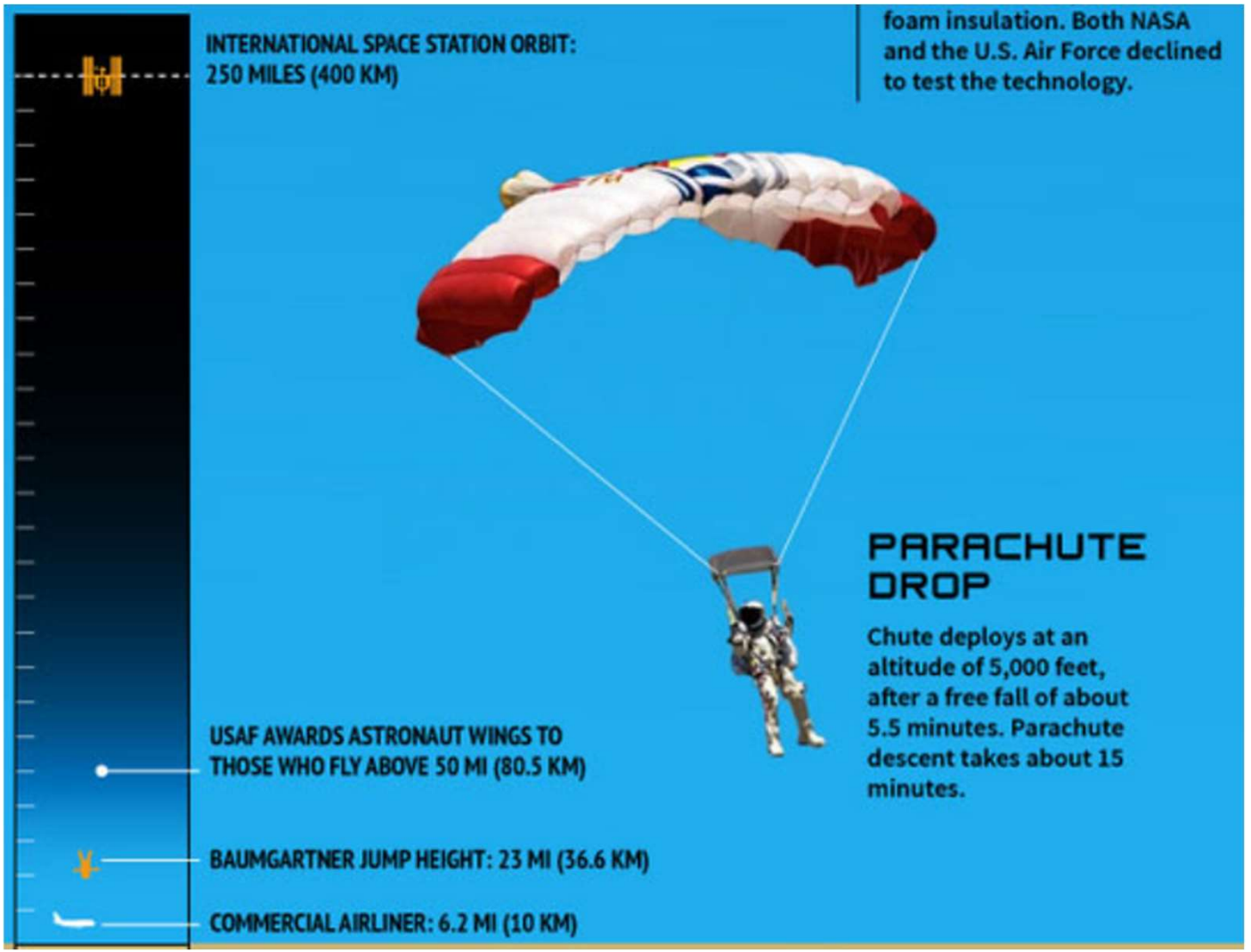

L4
L3
L1
L2
L5


GATEWAY CONFIGURATION CONCEPT
esa
ESPRIT
esa
JAXA
International Habitation Module
CSA ASC
Robotics
NASA
U.S. Habitation Module
ROSCOSMOS
Multi-Purpose Module
esa
Orion Service Module
NASA
Power and Propulsion Element
U.S. Utilization Module
Logistics Resupply
Orion Crew Module
NASA
NASA
JAXA
NASA
A DEEP SPACE HUB FOR SCIENCE AND EXPLORATION COLLABORATION
Command Module for Lunar Surface Assets
Internal and External Payloads
Internal and External Robotics
Mixed Fleet Deliveries
Human Lunar Surface Systems
International Crew
EXPLORE
MOON to MARS




4 PROPOSED ORBITS
FOR THE LUNAR SPACEPORT
North L1
North L2
Earth
Moon
South L1
South L2
Source: "Cislunar Near Rectilinear Halo Orbit for Human Space Exploration" NASA


WWW.REDBULLSTRATOS.COM
1st RECORD
PHASE 2
PHASE 3
2nd RECORD
36.500 m
35.000 m
33.500 m
32.000 m
30.500 m
29.000 m
27.500 m
26.000 m
24.400 m
23.000 m
21.300 m
19.800 m
18.300 m
16.800 m
15.200 m
13.700 m
12.200 m
10.700 m
9.100 m
7.600 m
6.100 m
4.600 m
3.000 m
1.500 m
Sea level
Joe Kittinger
31.300 m
PHASE 4
3rd RECORD
Weather Balloon
24.000 - 30.000 m
PHASE 5
4th RECORD
STRATOSPHERE
TROPOPAUSE
Boeing 747
14.000 m
PHASE 6
TROPOSPHERE
Mount Everest
8.848 m
Insufficient oxygen
to sustain life
7.600 m
PHASE 7
PHASE 8
PHASE 1


INTERNATIONAL SPACE STATION ORBIT:
250 MILES (400 KM)
foam insulation. Both NASA and the U.S. Air Force declined to test the technology.
PARACHUTE DROP
Chute deploys at an altitude of 5,000 feet, after a free fall of about 5.5 minutes. Parachute descent takes about 15 minutes.
USAF AWARDS ASTRONAUT WINGS TO THOSE WHO FLY ABOVE 50 MI (80.5 KM)
BAUMGARTNER JUMP HEIGHT: 23 MI (36.6 KM)
COMMERCIAL AIRLINER: 6.2 MI (10 KM)

Watch the record breaking space jump from 24.2 miles(38.9 km) above the surface of earth by 'Felix Baumgartner'. The video features the recording from the on-board camera, giving a true and absolute experience of the jump. It also features a free fall which breaks the sound barrier (speed of sound) at 846 miles/hr or 1361.5 km/hr without the use of any heavy machinery.

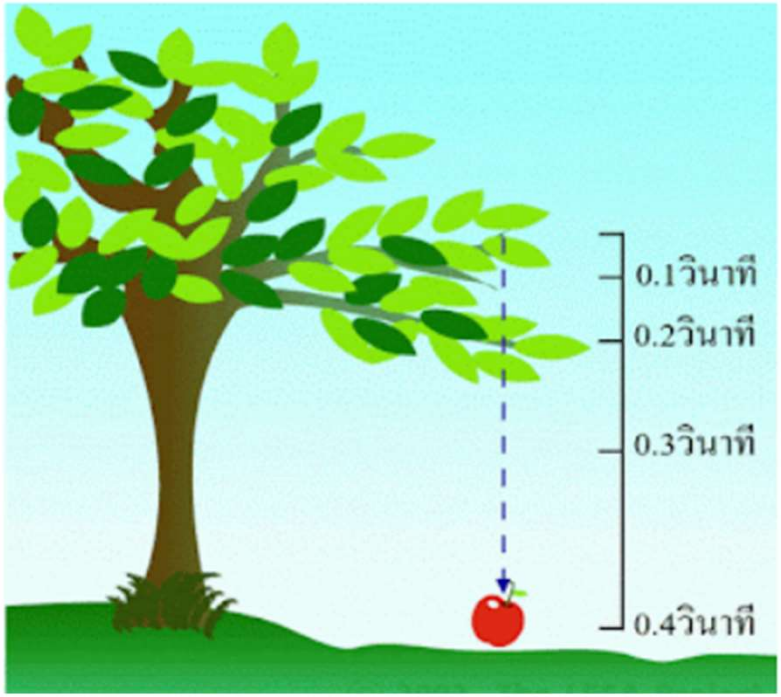
Record breaking space jump - free fall faster than speed of sound - Red Bull

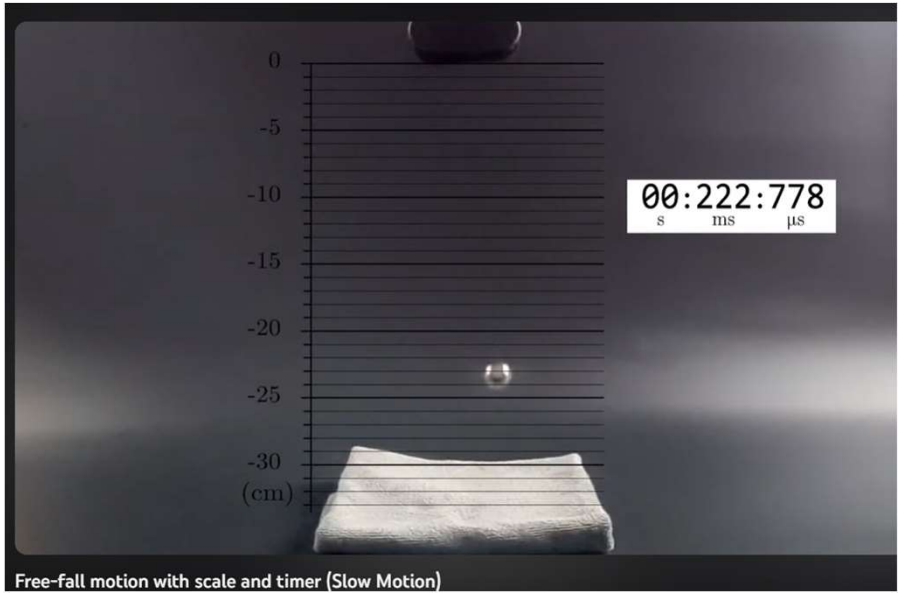
https://youtu.be/mJxsj51d-Pk?t=221

World's Longest Ever Ski Jump (New Record)

Quest for Speed: speed skating World Record with Kjeld Nuis.

นิวตันค้นพบค่าคงที่ของแรงโน้มถ่วง ($G = 6.67 \times 10^{-11}$ N m^2/kg^2) โดยอธิบายว่า แอปเปิลหล่นโดยมีความเร็วไม่คงที่ แรงโน้มถ่วงทำให้แอปเปิลมีความเร่ง 9.8 เมตร/วินาที^{2} ภาพที่ 9 แสดงให้เห็นว่า ทุกๆ ช่วงเวลา 0.1 วินาทีที่ผ่านไป แอปเปิลมีความเร็วเพิ่มขึ้น จึงเคลื่อนที่ได้ระยะทางมากขึ้น

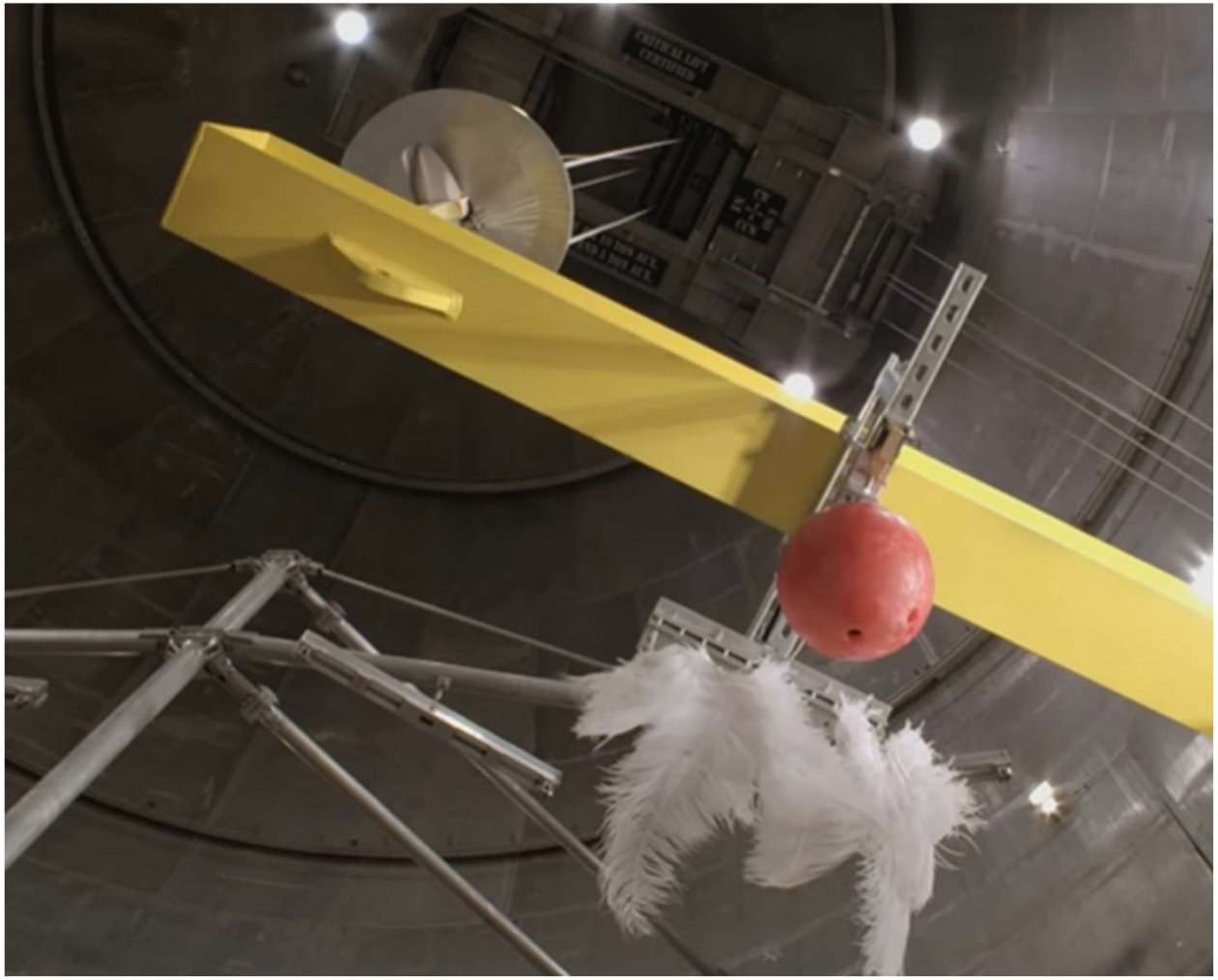




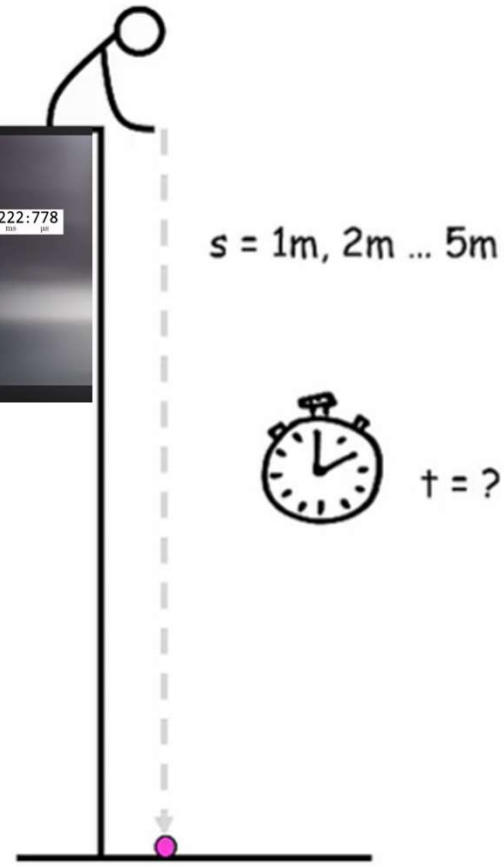
ความเร่งคืออะไร

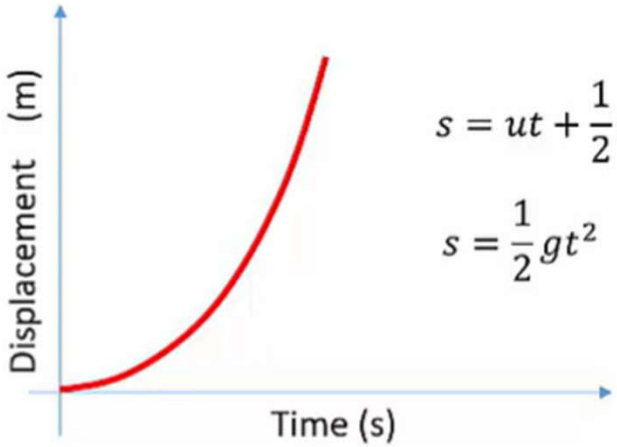
- ความเร็ว (Velocity) หมายถึง ระยะกระจัดที่วัตถุเคลื่อนที่ไปใน 1 หน่วยของเวลา (ระยะกระจัด/เวลา)
- ความเร่ง (Acceleration) หมายถึง ความเร็วของวัตถุที่เปลี่ยนแปลงไปใน 1 หน่วยเวลา (ระยะกระจัด/เวลา)/เวลา

http://www.lesa.biz/astronomy/cosmos/newton



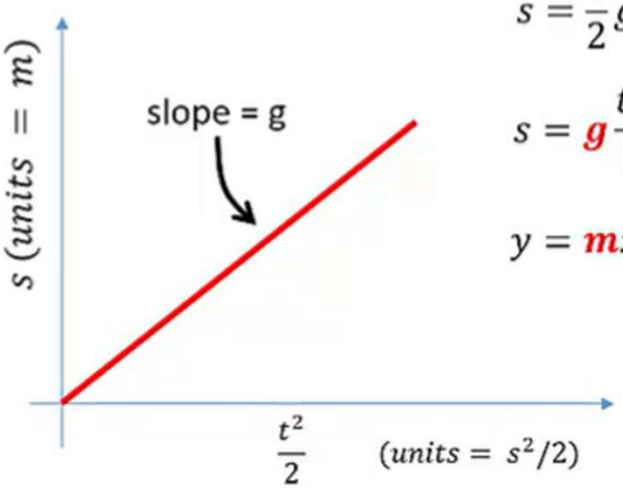
https://www.youtube.com/watch?v=E43-CfukEgs&t=237s





$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{1}{2}gt^2$$

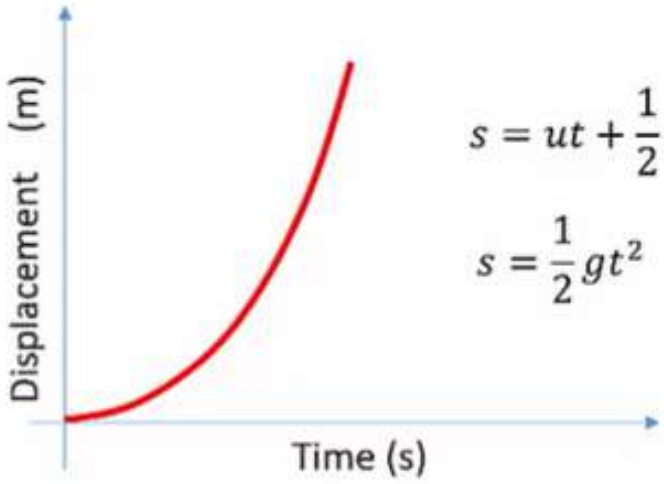


$$s = \frac{1}{2}gt^2$$

$$s = \boldsymbol{g}\frac{t^2}{2} + \mathbf{0}$$

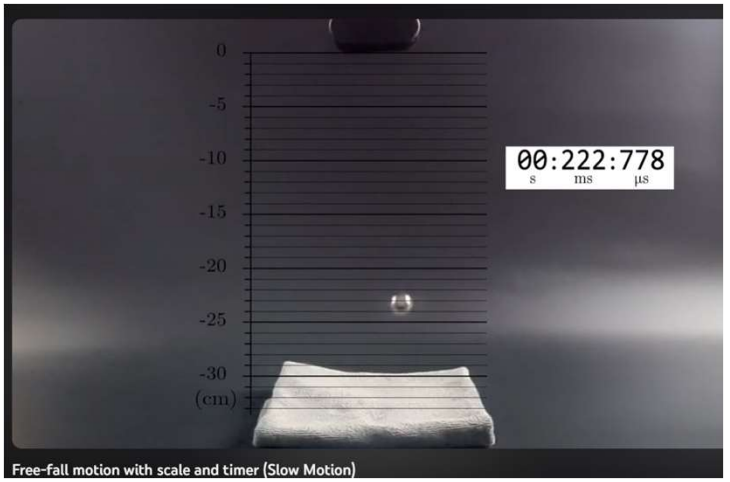
$$y = \boldsymbol{m}x + \boldsymbol{c}$$

Graphing your Freefall Experiment Data

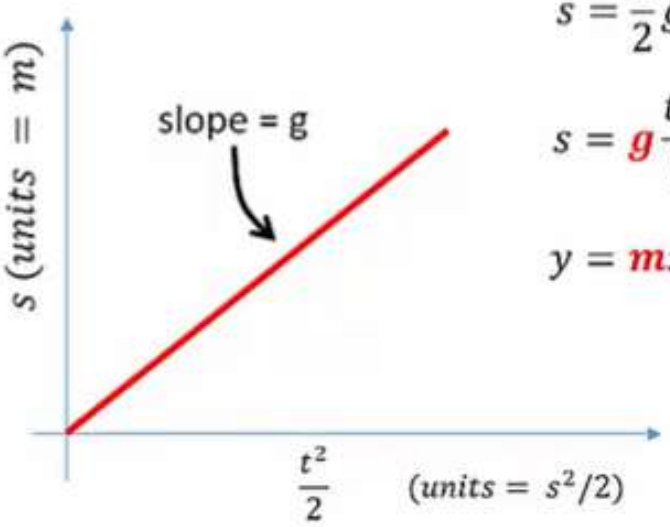


$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{1}{2}gt^2$$



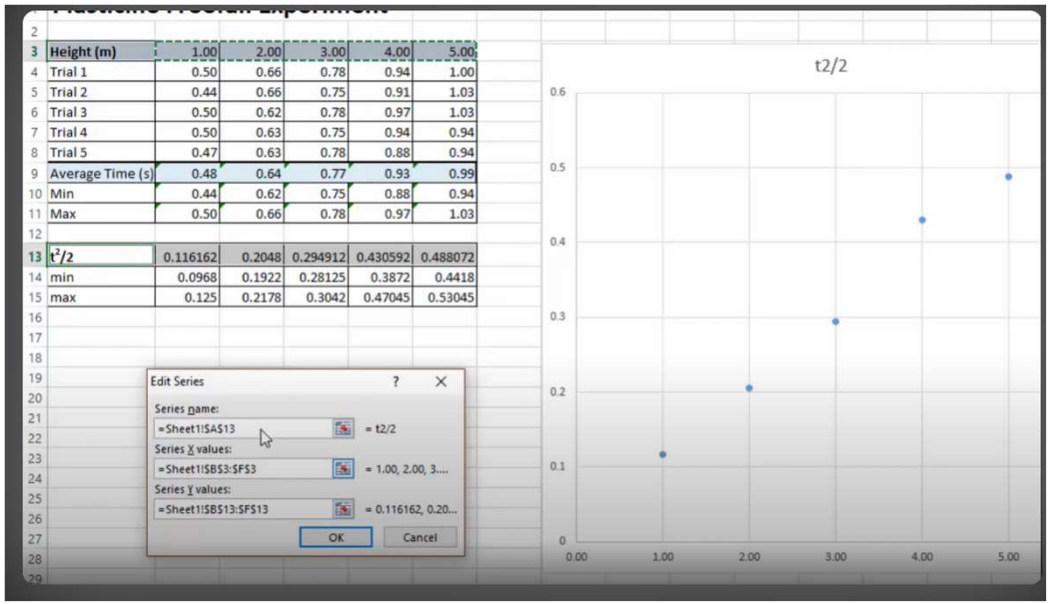
Free-fall motion with scale and timer (Slow Motion)



$$s = \frac{1}{2}gt^2$$

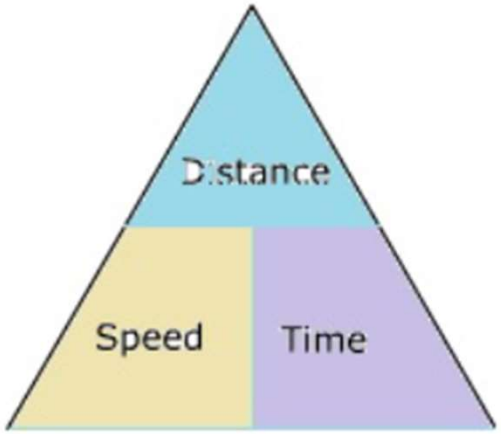
$$s = g\frac{t^2}{2} + 0$$

$$y = mx + c$$



	Height (m)	1.00	2.00	3.00	4.00	5.00
4	Trial 1	0.50	0.66	0.78	0.94	1.00
5	Trial 2	0.44	0.66	0.75	0.91	1.03
6	Trial 3	0.50	0.62	0.78	0.97	1.03
7	Trial 4	0.50	0.63	0.75	0.94	0.94
8	Trial 5	0.47	0.63	0.78	0.88	0.94
9	Average Time (s)	0.48	0.64	0.77	0.93	0.99
10	Min	0.44	0.62	0.75	0.88	0.94
11	Max	0.50	0.66	0.78	0.97	1.03
13	$t^2/2$	0.116162	0.2048	0.294912	0.430592	0.488072
14	min	0.0968	0.1922	0.28125	0.3872	0.4418
15	max	0.125	0.2178	0.3042	0.47045	0.53045

Difference between Speed and Velocity



$$v = \frac{d}{t}$$

v = speed
d = distance travelled
t = time taken

S=d/t

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

Average velocity is $\Delta v = \Delta x / \Delta t$

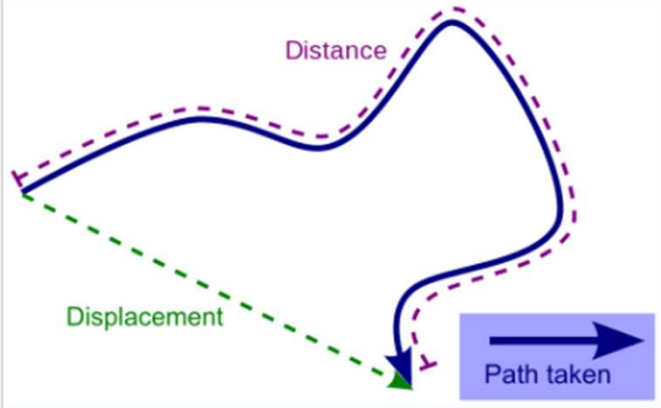
angular velocity is $\omega = \Delta\theta / \Delta t$

unit is m/s other units are ft/s, km/h

ระยะทางกับระยะกระจัด [แก้]

ระยะทางเป็นปริมาณสเกลาร์ที่ไม่สามารถเป็นจำนวนลบ และมีเพียงขนาด (magnitude) ในขณะที่ระยะกระจัด (displacement) จะเทียบเท่ากับปริมาณเวกเตอร์ที่มีทั้งขนาดและทิศทาง

ระยะทางที่นับโดยยานพาหนะ (ด้วยมาตรระยะทาง) หรือโดยคน สัตว์ สิ่งของ ฯลฯ ควรแยกแยะออกจากระยะกระจัดระหว่างจุดเริ่มต้นถึงจุดสิ้นสุด ถึงแม้ว่าจะหมายถึงระยะทางที่สั้นที่สุดก็ตาม เนื่องจากเส้นทางอาจมีการวนรอบ ซึ่งจุดสิ้นสุดสามารถเป็นจุดเดียวกับจุดเริ่มต้นก็ได้

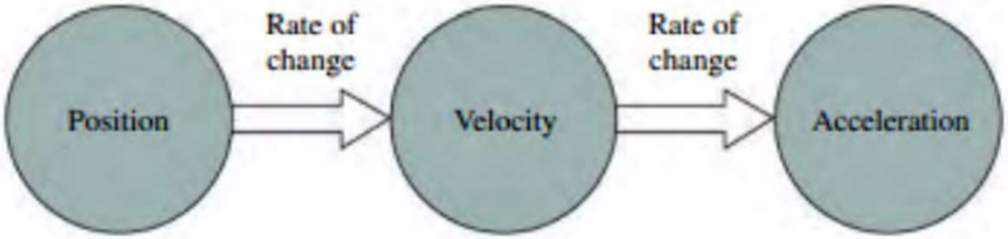


การเปรียบเทียบระหว่างระยะทาง (สีม่วง) กับระยะกระจัด (สีเขียว)

Motion in a Straight Line

Big Idea

The big ideas here are those of **kinematics**—the study of motion without regard to its cause. **Position**, **velocity**, and **acceleration** are the quantities that characterize motion:



$$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} \text{ หรือ } \vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1}$$

$\vec{a}$ = ความเร่ง (m/s^2)

$\Delta\vec{v}$ = ความเร็วสุดท้าย - ความเร็วเริ่มต้น (m)

Δt = ระยะเวลาทั้งหมดที่วัตถุใช้ในการเคลื่อนที่ (s)

$$s = vt$$

$$v = \frac{s}{t}$$

กรณีมีความเร่ง

$$v = u + at$$

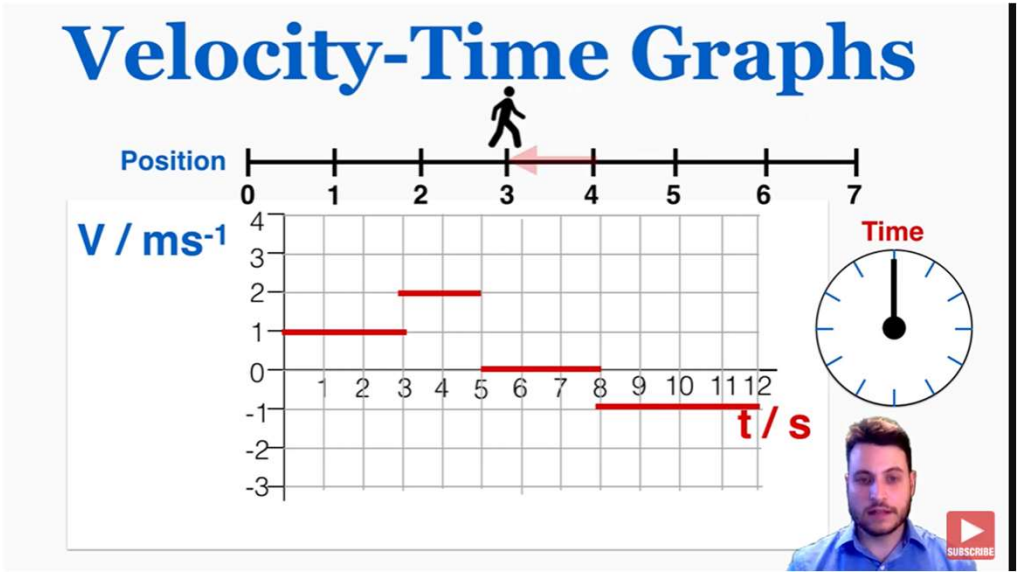
$$v^2 = u^2 + 2as$$

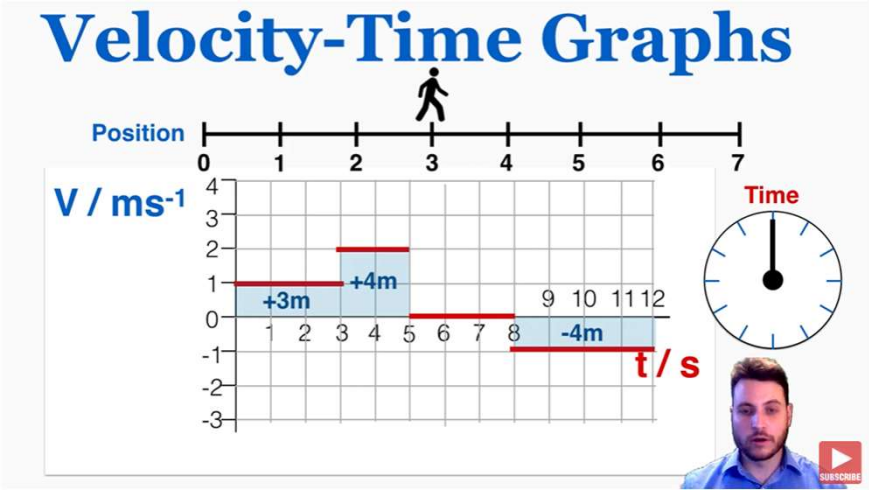
$$s = ut + \frac{1}{2}at^2$$

$$s = vt - \frac{1}{2}at^2$$

$$s = \left(\frac{v+u}{2}\right)t$$

https://www.youtube.com/watch?v=HTM8hGeNTVg&list=PLeveVE-rwOyLMMeJhlTKn33j4a7pml1ia&index=6



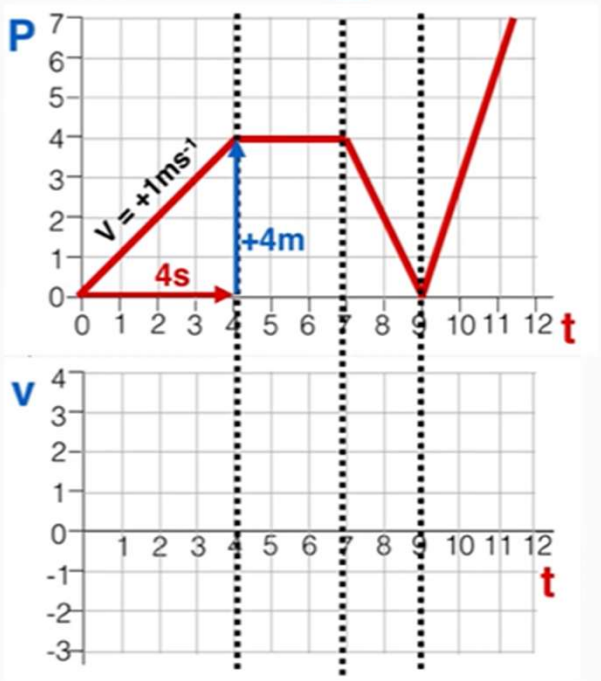


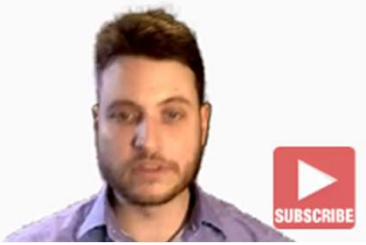
https://www.youtube.com/watch?v=-UwRQVFHWk0&list=PLeveVE-rwOyLMMeJhlTKn33j4a7pml1ia&index=7

Part 1: Position-Time to Velocity-Time Graphs

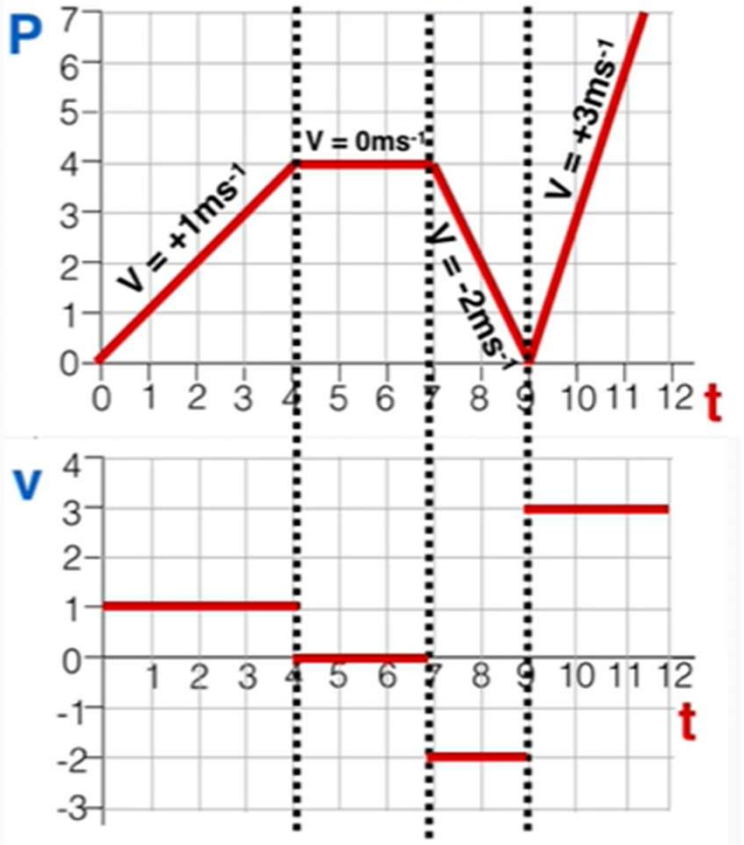
Example:

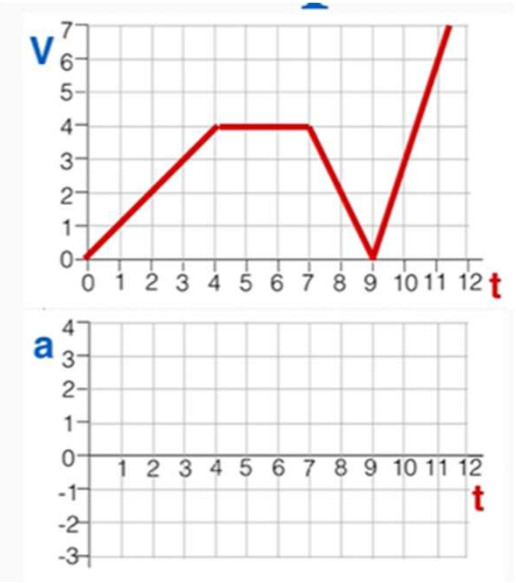
To translate from a position-time to a velocity-time graph, we can use the fact that the slope of the p-t graph is equal to the velocity at that time.





Example:





GRADIENT of a LINE:

The gradient m *of a line joining two points* $A(x_1,y_1)$ *and* $B(x_2,y_2)$ *is given by*

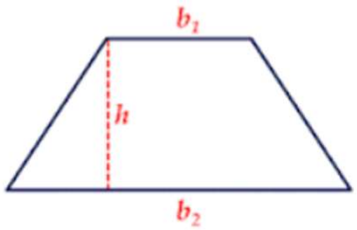
$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \text{ or } \frac{rise}{run}$$

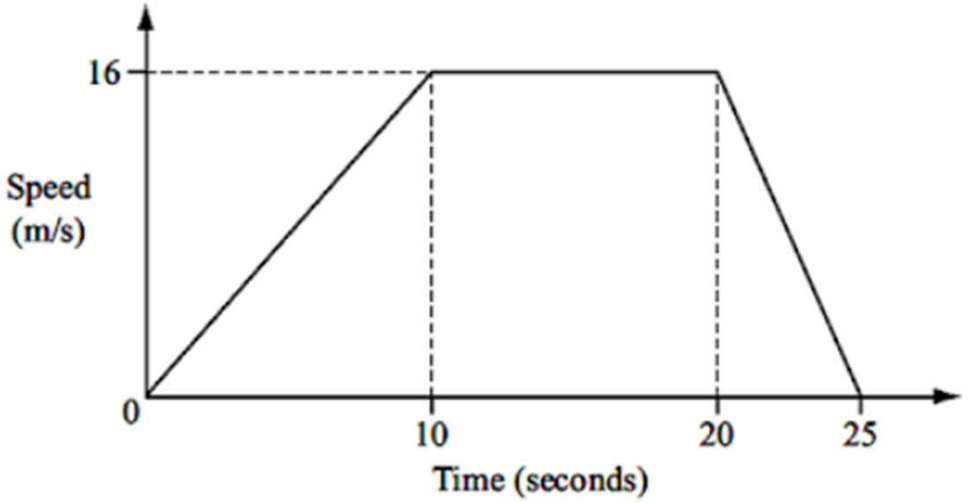
AREA of a TRAPEZIUM:

The area of a trapezium is given by

$$A = \frac{1}{2}(b_1 + b_2)(h)$$

where b_1 *and* b_2 *are the parallel sides (bases)*
h *is the height of the trapezium*



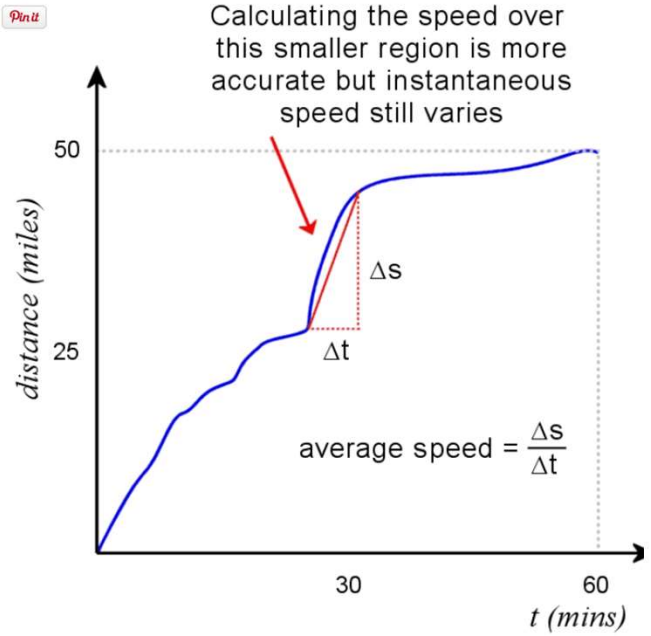


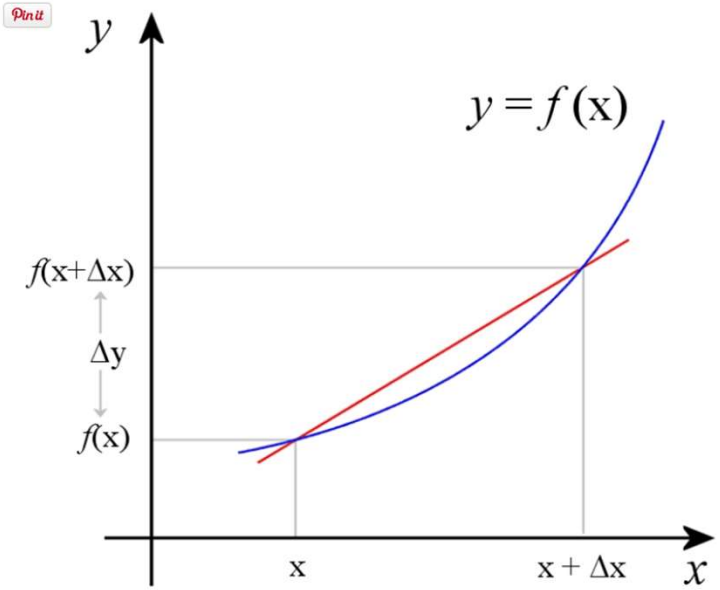
How to Understand Calculus
Differentiation

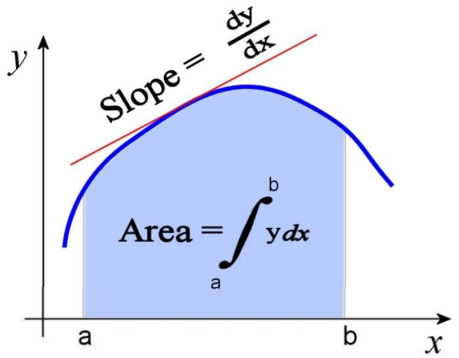
Constant: $\frac{d}{dx}(c) = 0$

Constant Multiple: $\frac{d}{dx}(cu) = c\frac{du}{dx}$

Power: $\frac{d}{dx}x^n = nx^{n-1}$







slope = $\frac{\text{change in y}}{\text{change in x}} = \frac{\Delta y}{\Delta x}$

$\frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{(x + \Delta x) - x}$

-เลขยกกำลัง (Exponential)

1. $a^m * a^n = a^{m+n}$
2. $\frac{a^m}{a^n} = a^{m-n}$
3. $a^0 = 1$ เมื่อ $a \in R$ แต่ $a \neq 0$
4. $a^{-n} = \frac{1}{a^n}$ เมื่อ $a \neq 0$
5. $(ab)^n = a^n b^n$

$$a^n = a \cdot a \cdot a \cdot a \cdot \ldots \cdot a$$

$$1.\ a^m \cdot a^n = a^{m+n}$$

$[-2]^4 = [-2][-2][-2][-2] = 16$

$-2^4 = -[2 \times 2 \times 2 \times 2] = -16$

พับกระดาษ 1 ครั้ง กระดาษถูกแบ่งออกเป็น 2 ส่วน

พับกระดาษ 2 ครั้ง กระดาษถูกแบ่งออกเป็น 2 x 2 = 4 ส่วน

พับกระดาษ 3 ครั้ง กระดาษถูกแบ่งออกเป็น 2 x 2 x 2 = 8 ส่วน

2^{10}

พับกระดาษ 10 ครั้ง กระดาษถูกแบ่งออกเป็น 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 1,024 ส่วน

General Formulas

Assume u and v are differentiable functions of x.

Constant: $\frac{d}{dx}(c) = 0$

Sum: $\frac{d}{dx}(u + v) = \frac{du}{dx} + \frac{dv}{dx}$

Difference: $\frac{d}{dx}(u - v) = \frac{du}{dx} - \frac{dv}{dx}$

Constant Multiple: $\frac{d}{dx}(cu) = c\frac{du}{dx}$

Product: $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$

Quotient: $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

Power: $\frac{d}{dx}x^n = nx^{n-1}$

Chain Rule: $\frac{d}{dx}(f(g(x)) = f'(g(x)) \cdot g'(x)$

Trigonometric Functions

$\frac{d}{dx}(\sin x) = \cos x$ $\quad$ $\frac{d}{dx}(\cos x) = -\sin x$

$\frac{d}{dx}(\tan x) = \sec^2 x$ $\quad$ $\frac{d}{dx}(\sec x) = \sec x \tan x$

$\frac{d}{dx}(\cot x) = -\csc^2 x$ $\quad$ $\frac{d}{dx}(\csc x) = -\csc x \cot x$

Constant: $\frac{d}{dx}(c) = 0$

Constant Multiple: $\frac{d}{dx}(cu) = c\frac{du}{dx}$

Power: $\frac{d}{dx}x^n = nx^{n-1}$

How to Understand Calculus

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