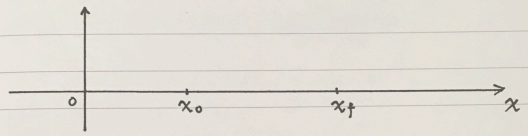
Table 1.2 Metric Prefixes for Powers of 10 and their Symbols

Prefix	Symbol	Value[1]	Example (some are approximate)			
exa	E	10^{18}	exameter	Em	10^{18} m	distance light travels in a century
peta	P	10^{15}	petasecond	Ps	10^{15} s	30 million years
tera	T	10^{12}	terawatt	TW	10^{12} W	powerful laser output
giga	G	10^{9}	gigahertz	GHz	10^{9} Hz	a microwave frequency
mega	M	10^{6}	megacurie	MCi	10^{6} Ci	high radioactivity
kilo	k	10^{3}	kilometer	km	10^{3} m	about 6/10 mile
hecto	h	10^{2}	hectoliter	hL	10^{2} L	26 gallons
deka	da	10^{1}	dekagram	dag	10^{1} g	teaspoon of butter
—	—	10^{0} (=1)				
deci	d	10^{-1}	deciliter	dL	10^{-1} L	less than half a soda
centi	c	10^{-2}	centimeter	cm	10^{-2} m	fingertip thickness
milli	m	10^{-3}	millimeter	mm	10^{-3} m	flea at its shoulders
micro	μ	10^{-6}	micrometer	μm	10^{-6} m	detail in microscope
nano	n	10^{-9}	nanogram	ng	10^{-9} g	small speck of dust
pico	p	10^{-12}	picofarad	pF	10^{-12} F	small capacitor in radio
femto	f	10^{-15}	femtometer	fm	10^{-15} m	size of a proton
atto	a	10^{-18}	attosecond	as	10^{-18} s	time light crosses an atom

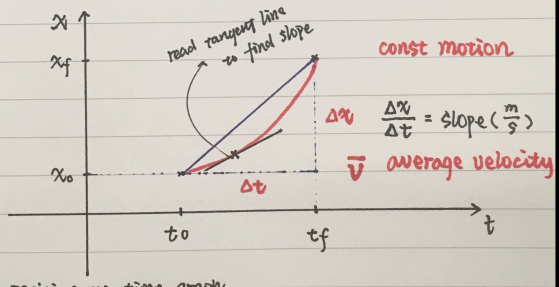
Unit 2

Motion in a straight line

Motion change in position over a time interval



displacement = $x_f - x_0 = \Delta x$ <m>



const motion

$\frac{\Delta x}{\Delta t}$ = slope ($\frac{m}{s}$)

$\bar{v}$ average velocity

position vs time graph

$\bar{v} = \frac{\Delta x}{\Delta t}$

Average Acceleration

$\bar{a} = \frac{\Delta v}{\Delta t}$ m/s²

2.14 A car is traveling to the left, which is the negative direction. The direction of travel remains the same throughout this problem. The car's initial speed is 11.0 m/s, and during a 7.34 -second interval, it changes to a final speed of **(a)** 13.4 m/s and **(b)** 7.58 m/s. In each case, find the average acceleration (magnitude and algebraic sign), **AND** state whether the car is speeding up or slowing down.

$\bar{a} = \frac{\Delta v}{\Delta t}$

7.34 s

1. 13.4 m/s
2. 7.58 m/s

× 11.0 m/s

negative $\bar{a}$, negative direction

$\frac{-13.4 \text{ m/s} - (-11 \text{ m/s})}{7.34 \text{ s}} = -0.327 \text{ m/s}^2$ speed up

$a_1 = \frac{13.4 - 11}{7.34} = 0.327$ m/s² speed up

$a_2 = \frac{7.58 - 11}{7.34} = -0.466$ m/s² slow down

$\frac{-7.58 \text{ m/s} - (-11 \text{ m/s})}{7.34 \text{ s}} = -0.466 \text{ m/s}^2$ slowing down

Velocity and Acceleration

1. When the velocity and acceleration of an object have the same algebraic sign, the object is speeding up.

2. When the velocity and acceleration of an object have opposite algebraic signs (i.e., one is positive the other negative), the object is slowing down.

2.34 A race driver has made a pit stop to refuel. After refueling, he starts from rest and leaves the pit area with an acceleration whose magnitude is 5.4 m/s^2; after 4.1 s he enters the main speedway. At the same instant, another car on the speedway and traveling at a constant velocity of 74.0 m/s overtakes and passes the entering car. The entering car maintains its acceleration. How much time is required for the entering car to catch up with the other car?

$V = V_0 + at$

$= 5.4\ m/s^2 * 4.1s = 22.14\ m/s$

$\Delta x = V_0 t + \frac{1}{2} a t^2$

$74t = 22.14\ m/s\ t + \frac{1}{2} * 5.4\ m/s^2\ t^2$

$74t = 22.14t + 2.7t^2$

$2.7t^2 - 74t + 22.14 = 0$

$\frac{74 \pm \sqrt{5476 - 239.112}}{5.4} = 27.1\ s$

$2.7t^2 - 51.86t = 0$

$\frac{51.86 + 51.86}{5.4} \approx 19.2\ s$

Equation

$$v = v_0 + at$$
$$\Delta x = \frac{1}{2}(v_0 + v)t$$
$$\Delta x = v_0 t + \frac{1}{2}at^2$$
$$v^2 = v_0^2 + 2a\Delta x$$

2.40 A Boeing 747 "Jumbo Jet" has a length of 59.7 m. The runway on which the plane lands intersects another runway. The width of the intersection is 21.1 m. The plane decelerates through the intersection at a rate of 5.80 m/s^2 and clears it with a final speed of 38.3 m/s. How much time is needed for the plane to clear the intersection?

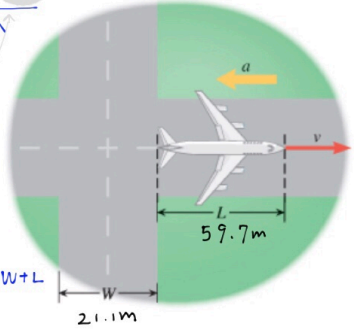
$V = V_0 + at$ $\quad t = \frac{V - V_0}{a}$

$V^2 = V_0^2 + 2a\Delta x$

$V_0 = \sqrt{V^2 - 2a\Delta x}$

$t = \frac{V - \sqrt{V^2 - 2a\Delta x}}{a}$

$t = 1.85s$



$V_0 = 38.3 + 5.8t$

$t = \frac{V - V_0}{a}$

$t = \frac{\Delta x}{\frac{1}{2}(V_0 + V)}$

$2t = \frac{80.8m}{38.3 + 5.8t + 38.3}$

$2t = \frac{80.8}{76.6 + 5.8t}$

$153.2t + 11.6t^2 - 80.8 = 0$