Unit 1: Kinematics
Lesson 1.2: Part 1 – One dimensional motion with constant acceleration

Kinematics: The study of motion

Dynamics: The study of the causes of motion – Forces.

Table 1 The Five Key Equations for Uniformly Accelerated Motion

	Equation	Variables found in equation	Variable not in equation
Equation 1	$\Delta\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right)\Delta t$	$\Delta\vec{d}, \Delta t, \vec{v}_f, \vec{v}_i$	$\vec{a}$
Equation 2	$\vec{v}_f = \vec{v}_i + \vec{a}\Delta t$	$\vec{v}_f, \vec{v}_i, \vec{a}, \Delta t$	$\Delta\vec{d}$
Equation 3	$\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$	$\Delta\vec{d}, \vec{v}_i, \Delta t, \vec{a}$	$\vec{v}_f$
Equation 4	$v_f^2 = v_i^2 + 2a\Delta d$	$v_f, v_i, a, \Delta d$	Δt
Equation 5	$\Delta\vec{d} = \vec{v}_f\Delta t - \frac{1}{2}\vec{a}\Delta t^2$	$\Delta\vec{d}, \vec{v}_f, \Delta t, \vec{a}$	$\vec{v}_i$

Example 1: Solving for Time and Displacement
A motorcyclist drives along a straight road with a velocity of 30.0 m/s [forward]. The driver applies the brakes and slows down at 5.0 m/s^2 [backward].

a) Calculate the braking time.
b) Determine the braking distance (displacement).

Example 2: Free Fall
When you let go of a ball, it will fall down because Earth's gravity pulls it down under an acceleration equivalent to the value of gravitational fields constant, $g = 9.8 m/s^2$.
A ball is thrown from a height of 52 m from the top of a building with a velocity of 24 m/s straight up.

a) Determine the velocity of the ball at ground level.
b) How long does it take for the all to reach the ground?

Unit 1: Kinematics
Lesson 1.2: Part 2 – Velocity, and Acceleration in Two Dimensions

Example 1: Displacement
A helicopter flies 65 km $[N32°E]$ and then 42 km $[E32°N]$. Determine the total displacement of the helicopter using both geometric method and vector component method.

Answer: $1.0 \times 10^2 km\ [E44°N]$
Pg. 25.

Example 2: Velocity
A family drives from Saint John, new Brunswick, to Moncton. Assuming a straight highway, this part of the drive has a displacement of 135.7 km $[E32.1°N]$. From Moncton, they drive to Amherst, Nova Scotia. The second displacement is 51.9 km $[E25.9°S]$. The total drive takes 2.5 h to complete.

a) Calculate the average velocity of the family's vehicle.
b) Calculate the average speed of the family's vehicle.

Pg. 31.

Example 3: Acceleration (Vector subtraction)

A car turns from a road into a parking lot and into an available parking space. The car's initial velocity is 4.0 m/s $[E45.0°N]$. The car's velocity just before the driver decreases speed is 4.0 m/s $[E\ 10.0°N]$. The turn takes 3.0 s. Calculate the average acceleration of the car during the turn.

Practice:

A ball on a pool table bounces off the rail (side), as shown in **Figure 5**. The ball is in contact with the rail for 3.2 ms. Determine the average acceleration of the ball. T/I A