Key Concepts
Part 1 - Motion in a Straight Line (One Dimension)

After completing this chapter you will be able to:
- explain how distance, position, and displacement are different
- explain how speed, velocity, and acceleration are different
- explain how vectors and scalars are different
- add and subtract vectors using scale diagrams and algebraic methods
- obtain motion information from position–time, velocity–time, and acceleration–time graphs
- solve uniform velocity and uniform acceleration problems using algebraic methods
- describe how the acceleration due to gravity affects the motion of objects close to the surface of Earth
- assess the impact on society and the environment of a technology that applies concepts related to kinematics

Sep 4-9:02 PM

Table 1 The Five Key Equations of Accelerated Motion

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

Learning Goal: By the end of today, I will be able to solve problems algebraically that involve the gravitational acceleration constant.

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Section 1.6 - Acceleration Due to Gravity - Near the Earth's Surface

All objects with Mass experience an attractive force that is referred to as Gravity.

The Sun's gravitational pull is what keeps the planets in their orbits.

The Earth's gravitational pull is what causes objects to fall to the ground when they are not supported.

The gravitational pull (force) on Earth causes objects to fall with an ACCELERATION of 9.8 m/s^2 or 32.2 ft/s^2.

As we will learn in our next unit, the force of gravity is dependent on how close the two objects are together. Thus gravitational force, and consequently the acceleration due to gravity varies somewhat around the globe.

The symbol for the acceleration due to gravity is "g".

The direction of the acceleration is always towards the Earth and is usually represented with a "negative" sign to communicate "down". ie. $-9.8 m/s^2$

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Example 1

A flowerpot is knocked off a window ledge and accelerates uniformly to the ground. If the window ledge is 10.0 m above the ground and there is no air resistance, how long does it take the flowerpot to reach the ground?

What is given?

What equations might be of use?

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Table 1 The Five Key Equations of Accelerated Motion

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

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What is the final velocity of the flowerpot in Sample Problem 1 just before it hits the ground?

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A ball is dropped from the roof of a building. If it takes the ball 2.6 s to reach the ground, how tall is the building?

A hot air balloon is hovering at height of 52 m above the ground. A penny is dropped from the balloon. Assume no air resistance.
(a) How long does it take the penny to hit the ground?
(b) What is the final velocity of the penny just before it hits the ground?

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Determining the Height Reached by a Ball Thrown Straight Up in the Air

A tennis ball is thrown straight up in the air, leaving the person's hand with an initial velocity of 3.0 m/s, as shown in Figure 2.

How high, from where it was thrown, does the ball go?

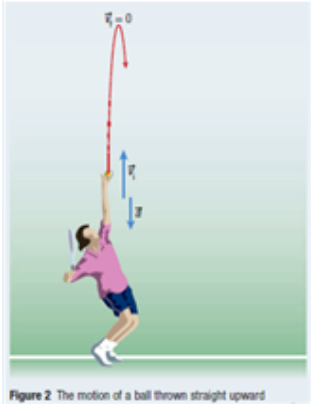

Figure 2 The motion of a ball thrown straight upward

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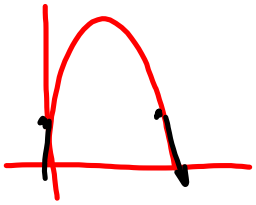
Practice

A golf ball is thrown straight up in the air at a velocity of 8.3 m/s.
(a) Determine the maximum height of the golf ball
(b) How long will it take the ball to reach its maximum height?
(c) How long will it take the ball to fall from its maximum height to the height from which it was initially launched?



A rock is thrown downward from a bridge that is 12 m above a small creek. The rock has an initial velocity of 3.0 m/s downward. What is the velocity of the rock just before it hits the water?

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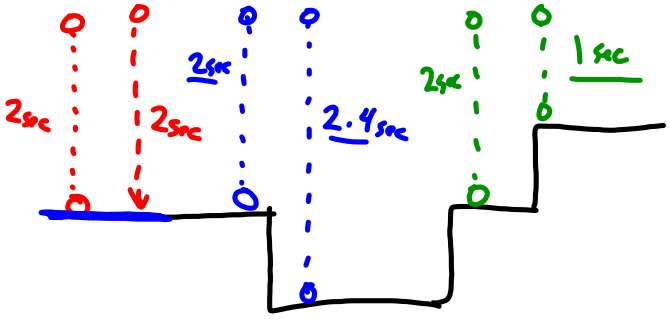
When times change...



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1.6 Questions

1. Describe the motion of an object that is dropped close to Earth's surface. K/U C
2. A basketball player jumps up to make a basket and appears to "hang" in mid-air. Write a brief description explaining to a Grade 9 student what is occurring and why. C
3. A baseball is thrown straight up in the air, reaches its maximum height, and falls back down to the height from which it was originally thrown. What is the acceleration of the ball
   (a) halfway up to its maximum height?
   (b) at its maximum height?
   (c) halfway back down to the initial height from which it was thrown? TA
4. A rubber ball is dropped from a height of 1.5 m. TA
   (a) How long does it take to hit the ground?
   (b) What is the velocity of the ball when it has travelled a distance halfway to the ground?
5. An arrow is shot straight up into the air at 80.0 m/s. TA
   (a) What is the arrow's maximum height?
   (b) How long does the arrow take to reach its maximum height?
   (c) Determine the total amount of time that the arrow is in the air.
6. A rock is thrown down from the top of a cliff with a velocity of 3.61 m/s [down]. The cliff is 28.4 m above the ground. Determine the velocity of the rock just before it hits the ground. TA
7. Describe the motion of the object represented by the velocity–time graph in **Figure 4**. Give an example of an object that might undergo this type of motion. K/U

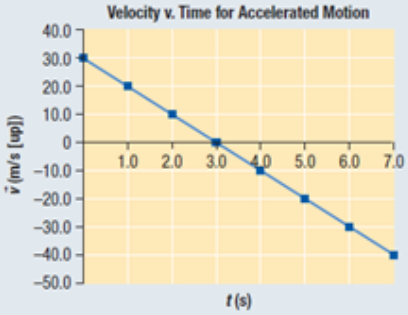

Figure 4

8. Research and describe a real-life situation where an object or person experiences an acceleration greater than g (9.8 m/s^2). A

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