Module 3: Motion in one dimension

3.1 Horizontal Motion

Uniformly Accelerated Rectilinear Motion

OBJECTIVES:

1. Differentiate distance and displacement
2. Differentiate speed and velocity (average and instantaneous)
3. Define kinematics
4. Differentiate uniform motion and uniformly accelerated motion
5. Solve problems involving the 4 kinematics equations

Distant vs Displacement

- Distance and displacement are two quantities that may seem to mean the same thing yet have distinctly different definitions.

- **Distance** is a scalar quantity that refers to "how much ground an object has covered" during its motion.

x - horizontal motion / y - vertical motion

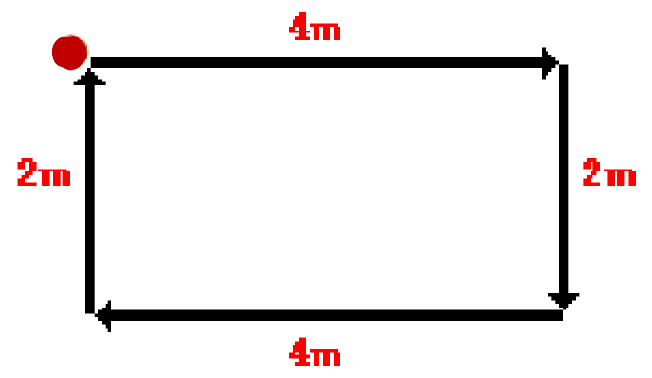
- **Displacement** is a vector quantity that refers to "how far out of place an object is"; it is the object's overall change in position.

x - positive always

d - either be positive or negative

↑ → - positive / ← ↓ - negative

Example: From rest, Christine walked 4 meters to the right, 2 meters south, another 4 meters to the left, and finally 2 meters north.



1) WHAT IS THE DISTANCE COVERED BY HER?

2) WHAT IS HER DISPLACEMENT FROM HER INITIAL POSITION?

1) $x = 4m + 2m + 4m + 2m = 12m$

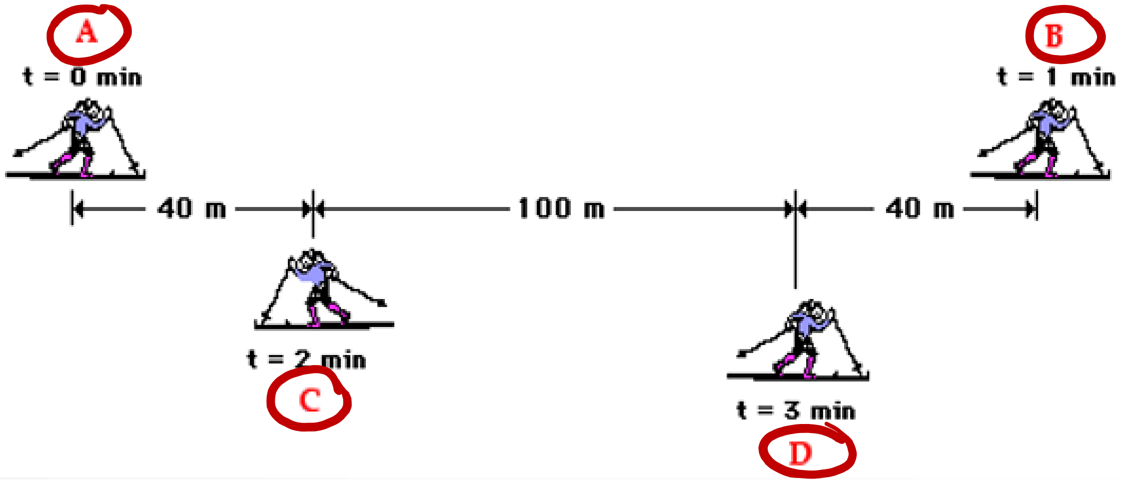
2) $d = +4m + (-2m) + (-4m) + (+2m)$
$= 0m$

Distant vs Displacement

Think about it…

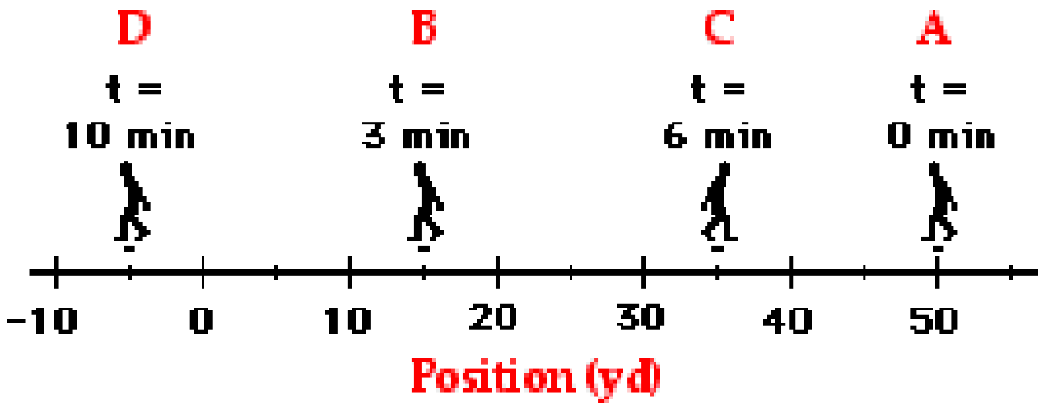
- Use the diagram to determine the resulting displacement and the distance traveled by the skier during these three minutes.

x position vs time



https://www.physicsclassroom.com/class/1DKin/Lesson-1/Distance-and-Displacement

- Consider a football coach pacing back and forth along the sidelines. In other words, the coach moves from position A to B to C to D. What is his displacement and distance covered?



https://www.physicsclassroom.com/class/1DKin/Lesson-1/Distance-and-Displacement

Ave. speed vs. Ave. velocity

- Imagine that a car begins traveling along a road starting at rest in an initial position given by:

$$x(t=0) = 0\,miles$$

c) $s = \frac{x}{t} = \frac{10\,mi}{6\,s} = 1.67\,mi/s$

$x_{t=0} = 0$

- After 2 seconds, the car then travelled 6 miles towards east represented by:

$$x(t=2) = 6\,miles$$

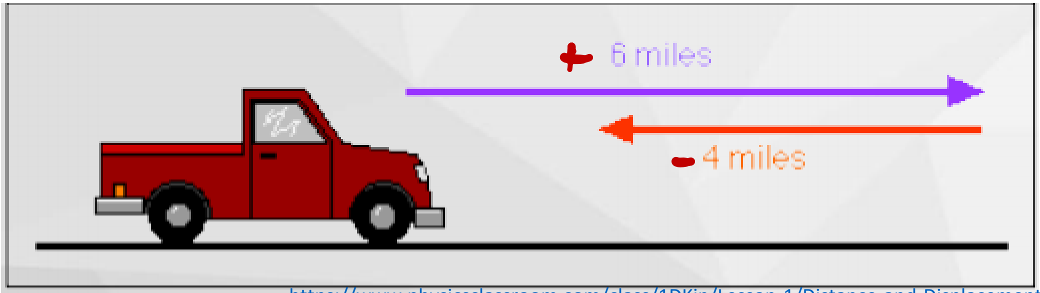
$x_{t=2} = 6\,mi$

- 4 seconds after reaching 6 miles from its initial position, the car then travelled 4 miles towards west represented by:

$$x(t=6) = 2\,miles$$

d) $v = \frac{d}{t} = \frac{2\,mi}{4\,s} = 0.5\,mi/s$

$x_{t=6} = 2\,miles$



https://www.physicsclassroom.com/class/1DKin/Lesson-1/Distance-and-Displacement

a WHAT IS THE TOTAL DISTANCE OF THE CAR? $x = 10\,mi$

b WHAT IS THE DISPLACEMENT OF THE CAR? $d = 2\,mi$

c WHAT IS THE AVERAGE SPEED OF THE CAR?

d WHAT IS THE AVERAGE VELOCITY OF THE CAR?

Ave. speed vs. Ave. velocity

Average speed refers to the **magnitude of how fast** an object travels **throughout its whole journey**. (SCALAR)

Average velocity refers to the **vector quantity describing how fast** an object travels **throughout its whole journey**. (VECTOR)

$$Average\ speed = \frac{distance}{time} = \frac{x_{total}}{\Delta t} = \frac{x}{t}$$

$$Average\ velocity = \frac{displacement}{time} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

$$= \frac{d}{t} = \frac{\Delta x}{t}$$

Δ - change

STEPS IN SOLVING FOR AVERAGE SPEED AND AVERAGE VELOCITY
Step 1: Draw the system.
Step 2: Determine what the problem asks for.
Step 3: Write and apply the formulas.
Step 4: Write the answer with confidence while smiling.

Inst. Speed vs. Inst. Velocity

- **Instantaneous speed** – the actual speed of an object has at any moment.
- **Instantaneous velocity** – the actual velocity of an object has at any moment.

$$V_{ins} = \frac{distance}{\Delta t} = \frac{\sum \Delta x}{t_2 - t_1}$$

$$\overrightarrow{V_{ins}} = \frac{displacement}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

Compare the formula for average speed and instantaneous speed.

TRIVIA – The speedometer of a car gives the instantaneous speed.

Try this on your own!!!

1. A man walks 7 km in 2 hours and 2 km in 1 hour in the same direction. (a) What is the man's average speed for the whole journey? (b) What is the man's average velocity for the whole journey?

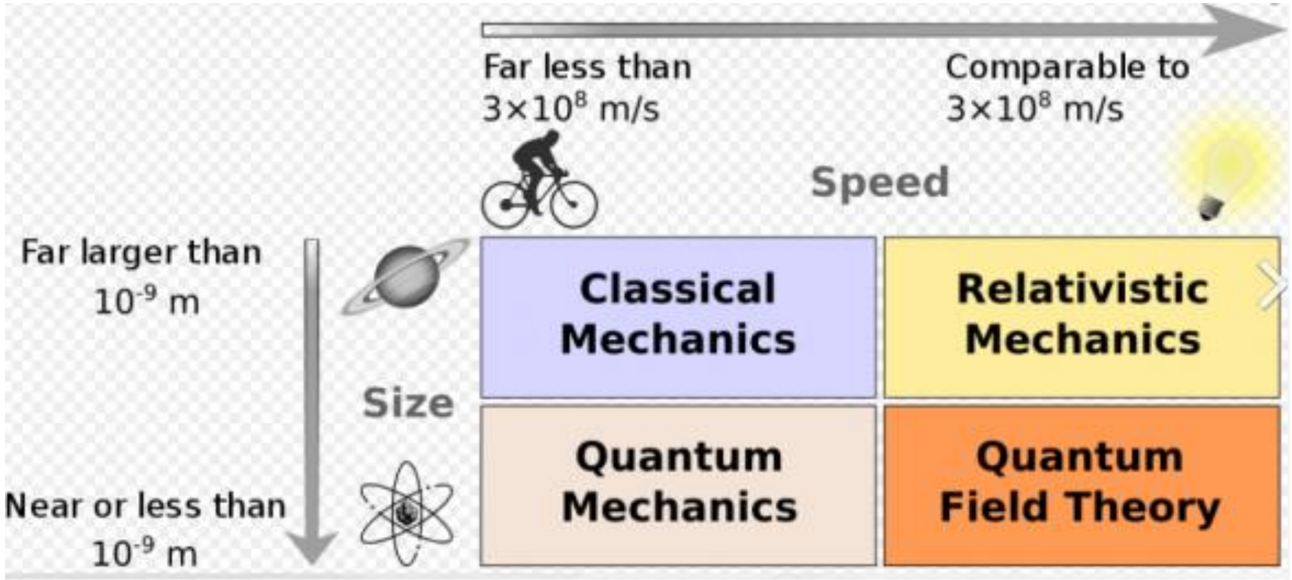
2. A man walks 7 km East in 2 hours and then 2 km West in 1 hour. (a) What is the man's average speed for the whole journey? (a) What is the man's average velocity for the whole journey?

3. Jake Peralta drove south 120 km at 60 km/hr and then east 150 km at 50 km/hr. (a) What is his average speed for the whole journey? (a) What is his average velocity for the whole journey?

Kinematics

- Kinematics analyzes the positions and motions of objects as a function of time without regard to the causes of motion.

- It involves the relationships between the quantities displacement (d), velocity (v), acceleration (a), and time (t).



KINEMATICS EQUATIONS

$$v_f = v_o + at \quad 1$$

$$d = \Delta x = \left(\frac{v_f + v_o}{2}\right) t \quad 2$$

$$d = \Delta x = v_o t + \frac{1}{2} a t^2 \quad 3$$

$$v_f^2 = v_o^2 + 2a\Delta x \quad 4$$

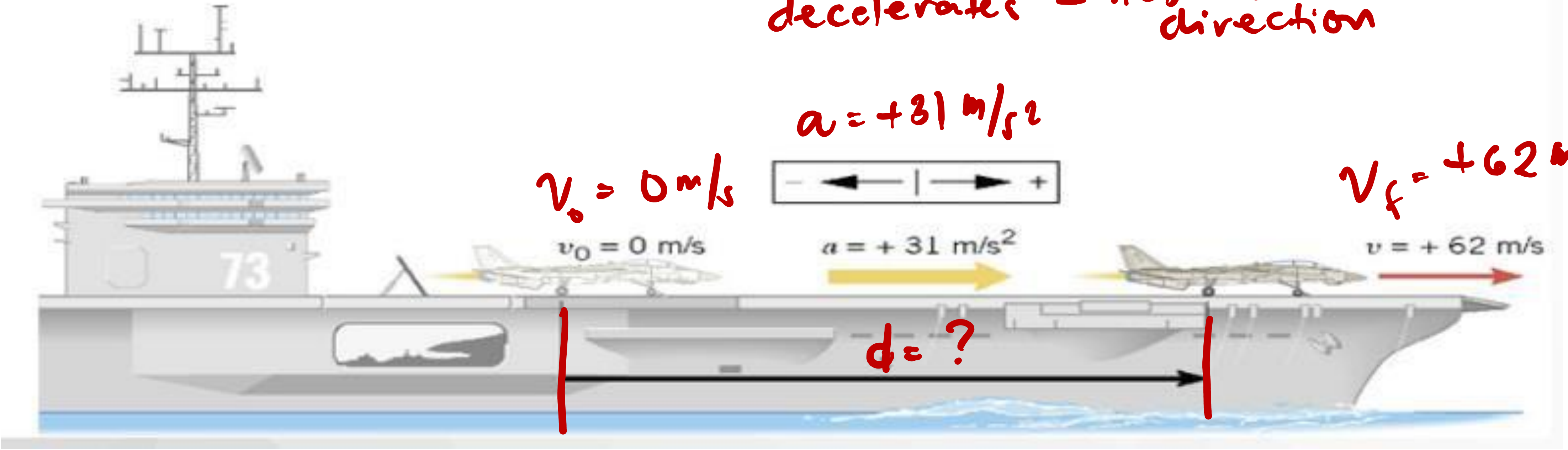
$\mathbf{v_f}$ - final velocity
$\mathbf{v_o}$ - initial velocity
a – acceleration
t- time
d ~~Δ**x**~~ – position (displacement)

- Always depend on the given when choosing which equation to use.
- MEMORIZE THEM FOR SURVIVAL!

Kinematic Examples (horizontal)

1. The jet plane starts from rest, accelerates with 31 m/s^2, and assumes a speed of 62 m/s before its takeoff from the ship. Determine its displacement before takeoff.

decelerates – negative direction



https://web.pa.msu.edu/courses/2012summer/PHY231/lectures/section_1/ch02_1_S1_pre.pdf

Problem-Solving Strategy

1. Identify **known values** of 3 variables. Write down; relate to the symbols.
2. Identify the **unknown**. Write in symbol form.
3. Find the kinematic equation. Write down.
4. Substitute known values into equation.
5. Solve for unknown.

Given

Required

Equation???

solution

Final answer

Kinematic Examples (solution)

Ex. 1

Given:

$v_0 = 0\ m/s$

$v_f = +62\ m/s$

$a = 31\ m/s^2$

req'd: $d =$ ______

decelerate $= -31\ m/s^2$

nega. direction.

Solution: $v_f^2 = v_0^2 + 2ad$

$$(62\ m/s)^2 = 0\ m/s + 2(31\ m/s^2)d$$

$$\frac{3844\ m^2/s^2}{62\ m/s^2} = \frac{\cancel{62\ m/s^2} \cdot d}{\cancel{62\ m/s^2}}$$

$$\boxed{d = 62\ m}\ + \rightarrow$$

Problem-Solving Strategy

1. Identify **known values** of 3 variables. Write down; relate to the symbols.
2. Identify the **unknown**. Write in symbol form.
3. Find the kinematic equation. Write down.
4. Substitute known values into equation.
5. Solve for unknown.

2. A racer can achieve an average acceleration of 26.0 m/s². Suppose a racer accelerates from rest at this rate for 5.56 s.

$v_0 = 0$

How far does it travel in this time?

$d =$ ______ ?

U.S. Army Top Fuel pilot Tony "The Sarge" Schumacher begins a race with a controlled burnout. (credit: Lt.Col. William Thurmond. Photo Courtesy of U.S. Army.)

Kinematic Examples (solution)

Ex. 2

Given:

$a = 26\ m/s^2$

$v_0 = 0\ m/s$

$t = 5.56\ s$

Req'd:

$d = \underline{\qquad}\ ?$

Solution:

$d = v_0 t + \frac{1}{2} a t^2$

$= \cancel{(0\ m/s)(5.56\ s)}^{\,0} + \frac{1}{2}(26\ m/s^2)(5.56\ s)^2$

$\underline{d = 401.88\ m}$ //

3. A racer can achieve an average acceleration of 26.0 m/s². Suppose a racer accelerates from rest at this rate.

$= a$

$(v_0 = 0)$

Calculate the final velocity of the racer, if t is unknown.

$d = 401.88\ m$

$t = ?$

U.S. Army Top Fuel pilot Tony "The Sarge" Schumacher begins a race with a controlled burnout. (credit: Lt.Col. William Thurmond. Photo Courtesy of U.S. Army.)

Problem-Solving Strategy

1. Identify **known values** of 3 variables. Write down; relate to the symbols.
2. Identify the **unknown**. Write in symbol form.
3. Find the kinematic equation. Write down.
4. Substitute known values into equation.
5. Solve for unknown.

Given

$a = 26\ m/s^2$

$v_0 = 0\ m/s$

$d = 401.88\ m$

Req'd:

$t =$ ______ ?

Solution

$$d = v_0 t + \frac{1}{2} a t^2$$

$$401.88\ m = \cancel{(0\ m/s)(t)} + \frac{1}{2}(26\ m/s^2)\, t^2$$

$$\frac{401.88\ \cancel{m}}{13\ m/s^2} = \frac{(13\ \cancel{m/s^2})\, t^2}{\cancel{13\ m/s^2}}$$

$$\sqrt{30.91\ s^{\cancel{2}}} = \sqrt{t^{\cancel{2}}}$$

$$\sqrt{30.91}\ s = t$$

$$\boxed{t = 5.56\ s}$$

Try This!!!

1. Summer is jogging with an initial velocity of 4 m/s when she accelerates at 2 m/s^2 for 3 seconds. How fast is Summer running now?

2. Rick's spaceship accelerates down a runway at 3.20 m/s^2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before takeoff.

3. A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds. Determine the acceleration of the car and the distance traveled.

4. A bike accelerates uniformly from rest to a speed of 7.10 m/s over a distance of 35.4 m. Determine the acceleration of the bike.

5. A car was traveling at 12 m/s when the driver stepped on the brakes. If the car comes to a full stop in 5.0 s, what was its acceleration? What distance did it cover?

KINEMATICS EQUATIONS

$$v_f = v_o + at$$

$$\Delta x = \left(\frac{v_f + v_o}{2}\right)t$$

$$\Delta x = v_o t + \frac{1}{2}at^2$$

$$v_f^2 = v_o^2 + 2a\Delta x$$

$\mathbf{v_f}$ - final velocity
$\mathbf{v_o}$ - initial velocity
a – acceleration
t- time
Δx – position

- Always depend on the given when choosing which equation to use.
- MEMORIZE THEM FOR SURVIVAL!

Kinematic Examples (horizontal)

A car was traveling at 12 m/s (v_i) when the driver stepped on the brakes. If the car comes to a full stop in 5.0 s, what was its acceleration? What distance did it cover?

Given:

$v_i = 12\ m/s$

$v_f = 0\ m/s$

$t = 5\ s$

Req'd:

$a = ?$

$d = ?$

a) $v_f = v_i + at$

$0 = 12\ m/s + a(5\ s)$

$\dfrac{-12\ m/s}{5\ s} = \dfrac{\cancel{5\ s}(a)}{\cancel{5\ s}}$

$\boxed{a = -2.4\ m/s^2}$

(deceleration)

b) $d = v_i t + \frac{1}{2} a t^2$

$= (12\ m/s)(5\ s) + \frac{1}{2}(-2.4\ m/s^2)(5\ s)^2$

$= 60\ m - 30\ m$

$\boxed{d = 30\ m}$

Problem-Solving Strategy

1. Identify **known values** of 3 variables. Write down; relate to the symbols.
2. Identify the **unknown**. Write in symbol form.
3. Find the kinematic equation. Write down.
4. Substitute known values into equation.
5. Solve for unknown.

$$v_f = v_o + at$$

$$\Delta x = \left(\frac{v_f + v_o}{2}\right)t$$

$$\Delta x = v_o t + \frac{1}{2}at^2$$

$$v_f^2 = v_o^2 + 2a\Delta x$$

Module 3: Motion in one dimension

3.2 Vertical Motion

OBJECTIVES:

1. Compare 1D horizontal motion to free fall motion
2. Identify the two main types of problems involving free falling bodies
3. Enumerate and apply the four free fall motion equations
4. Solve problems involving free falling bodies

Free Fall Motion

- Free fall motion is defined as the motion of any object that is being acted upon only by the force of gravity.

(gravitational force)

- No external net force should be involved (no air resistance).
- An object in a free fall state only moves along the y-axis.

(decelerates)

- All free-falling objects (on Earth) accelerate downwards at a rate of 9.8 m/s^2 (acceleration due to gravity).

https://www.physicsclassroom.com/class/1DKin/Lesson-5/Acceleration-of-Gravity

TAKE NOTE THAT FREE FALL MOTION IS STILL IN 1D KINEMATICS!

Free Fall Motion

Concept Check:

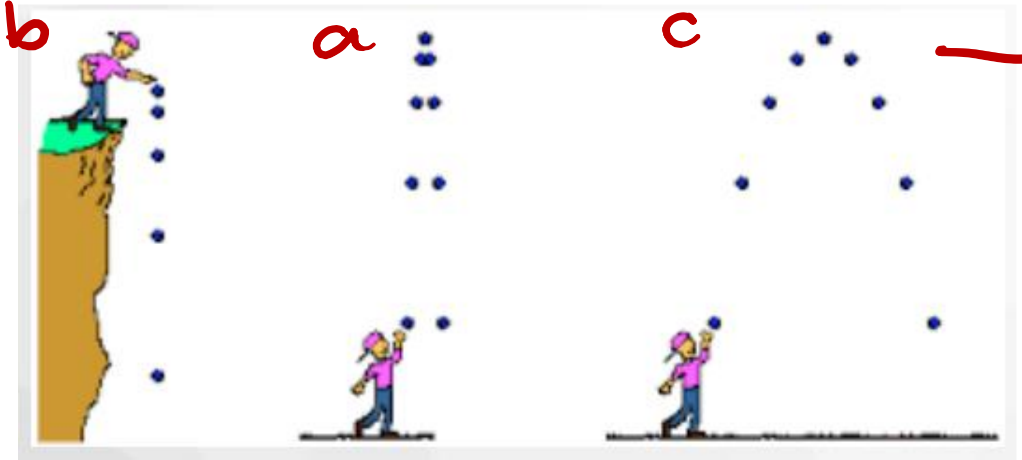
a ▪ Consider a ball thrown upwards with an angle of inclination of 90^0 with respect to the ground. What is the ball's change of position along the x-axis?

$\Delta y = y = 0$

b ▪ Consider a ball dropped straight downwards from the top of a building to the ground. What is the ball's change of position along the x-axis?

$y = 0$

c ▪ Considering the figure below, which of the following is NOT an example of a free fall motion?



→ projectile motion (2D)

https://www.physicsclassroom.com/class/1DKin/Lesson-5/Acceleration-of-Gravity

Acceleration due to Gravity

- Acceleration due to gravity is the rate at which an object changes its velocity due to the force of gravity.

- All objects dropped from the same height will hit the ground in the same amount of time, regardless of mass. (Assuming there is no external force involved)

- In a free fall motion, the acceleration due to gravity is ALWAYS negative equal to -9.8 m/s^2

- Whenever a problem mentions an object is "in free fall," "falling," "thrown, "tossed", or any other synonym, the constant value of acceleration due to gravity is assumed.

$$g = -9.8\ \frac{m}{s^2}$$

Remember the 4 Kinematics Equations in 1D Horizontal?

$a =$
$\Delta x =$

$$v_f = v_o + at$$

$$\Delta x = \left(\frac{v_f + v_o}{2}\right) t$$

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

$$v_f^2 = v_o^2 + 2a\Delta x$$

v_f - final velocity
v_o - initial velocity
a – acceleration
t- time
Δx – position

Here they are now in Free Fall!

$a = g$
$H \quad V$

$\Delta x = \Delta y$
$H \quad V$

$$v_f = v_o + \overset{a}{g}t$$

$$\overset{\Delta x}{\Delta y} = \left(\frac{v_f + v_o}{2}\right)t$$

$$\Delta y = v_o t + \frac{1}{2}gt^2$$

$$v_f^2 = v_o^2 + 2g\Delta y$$

v_f - final velocity
v_o - initial velocity
g – acceleration due to gravity (-9.8 m/s^2)
t- time
Δy – position along the vertical

Transformation 1D Horizontal to Free Fall Motion

$v_f = v_o + at$	$\longrightarrow$	$v_f = v_o + gt$
$\Delta x = \left(\frac{v_f + v_o}{2}\right)t$	$\longrightarrow$	$\Delta y = \left(\frac{v_f + v_o}{2}\right)t$
$\Delta x = v_o t + \frac{1}{2}at^2$	$\longrightarrow$	$\Delta y = v_o t + \frac{1}{2}gt^2$
$v_f^2 = v_o^2 + 2a\Delta x$	$\longrightarrow$	$v_f^2 = v_o^2 + 2g\Delta y$

The “Drop” type:

Quicksilver was mad at his sister Wanda. He took her iPhone 11 Pro Max and dropped it out the window of his bedroom. If the window is 8.75 m above the ground, determine the time required for the phone to reach the ground.

STEP 1: IDENTIFY THE TYPE OF THE PROBLEM
STEP 2: WRITE THE GIVEN
STEP 3: CHOOSE A FORMULA TO USE
STEP 4: DO THE MATH
STEP 5: WRITE THE FINAL ANSWER WHILE LAUGHING

NOTE: THE INITIAL VELOCITY FOR THE DROP TYPE OF PROBLEM IS ALWAYS EQUAL TO ZERO.

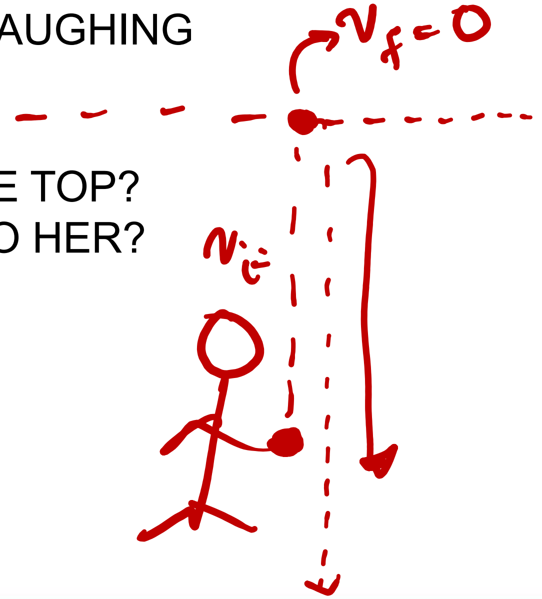
$$v_o = 0$$

The "Toss" type

Black Widow is broken hearted. She then tossed a rock straight up in the air with an initial velocity of 15 m/s. For how long will the rock be in the air?

STEP 1: IDENTIFY THE TYPE OF THE PROBLEM
STEP 2: WRITE THE GIVEN
STEP 3: CHOOSE A FORMULA TO USE
STEP 4: DO THE MATH
STEP 5: WRITE THE FINAL ANSWER WHILE LAUGHING

EXTRA QUESTIONS:
FOR HOW LONG WILL THE ROCK REACH THE TOP?
FOR HOW LONG WILL THE ROCK RETURN TO HER?



NOTE: THE FINAL VELOCITY FOR THE TOSS TYPE OF PROBLEM IS ALWAYS EQUAL TO ZERO.

$$v_f = 0$$

//THIS IS FOR THE POINT WHERE THE OBJECT IS AT THE MAXIMUM HEIGHT.

Kinematic Examples (Vertical)

1. The figure below shows the positions of a ball, at 1-s intervals, with an initial velocity of 4.9m/s downward, that is thrown from the top of a 98-m-high building.

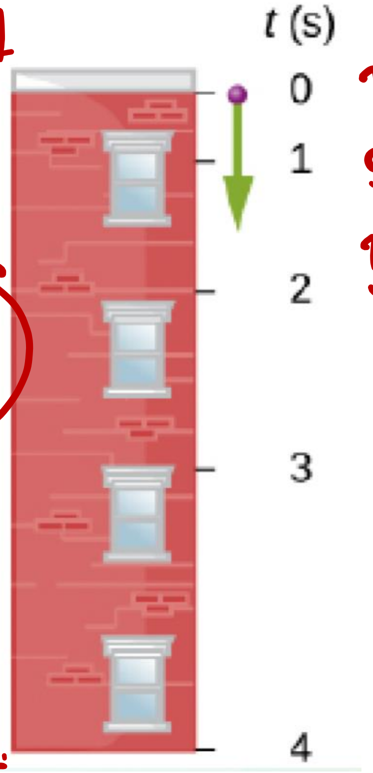
a) How much time elapses before the ball reaches the ground?

b) What is the velocity when it arrives at the ground?

start

98m

end



$v_i = 4.9\,m/s\ (-)$

$g = -9.8\,m/s^2$

$y = 98\,m\ (-)$

a) $y = v_i t + \frac{1}{2} g t^2$

$-98m = -4.9\,m/s\,(t) + \frac{1}{2}(-9.8\,m/s^2)\,t^2$

$-98m = -4.9\,\frac{m}{s}(t) - 4.9\,\frac{m}{s^2}(t)^2$

$0 = -4.9\,\frac{m}{s^2}\,t^2 - 4.9\,\frac{m}{s}\,t + 98m$

$0 = -4.9\,m\underbrace{\left[\frac{t^2}{s^2} + \frac{t}{s} - 20\right]}$

$t^2 + t - 20 = 0$

$(t+5)(t-4)$

roots: $t+5=0$, $\cancel{t=-5}$ | $t-4=0$, $t=4$

$\boxed{t = 4s}$ ✓

Problem-Solving Strategy

1. Identify **known values** of 3 variables. Write down; relate to the symbols.
2. Identify the **unknown**. Write in symbol form.
3. Find the kinematic equation. Write down.
4. Substitute known values into equation.
5. Solve for unknown.

$$v_f = v_o + gt$$

$$\Delta y = \left(\frac{v_f + v_o}{2}\right)t$$

$$\Delta y = v_o t + \frac{1}{2} g t^2$$

$$v_f^2 = v_o^2 + 2g\Delta y$$

Kinematic Examples (Vertical)

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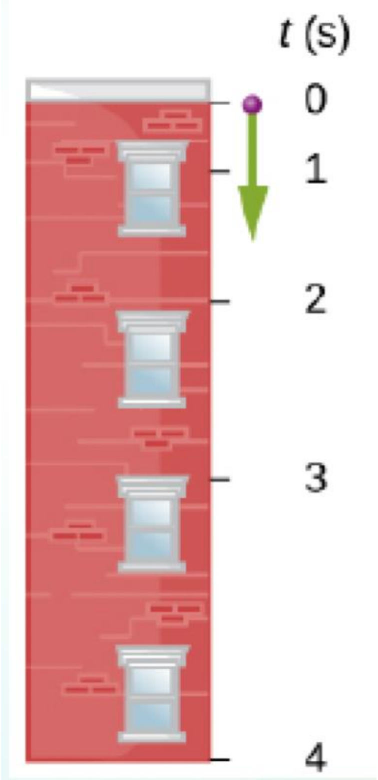

b) $v_f = v_i - gt$

$= -4.9\,m/s - 9.8\,m/s^2\,(4s)$

$= -4.9\,m/s - 39.2\,m/s^2$

$$\boxed{v_f = -44.1\,m/s}$$

44.1 m/s downward

Problem-Solving Strategy

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$$\Delta y = v_o t + \frac{1}{2}gt^2$$

$$v_f^2 = v_o^2 + 2g\Delta y$$

A construction worker accidentally drops a brick from a high scaffold.
a. What is the velocity of the brick after 4.0 s?
b. How far does the brick fall during this time?

Given: $g = -9.8\ m/s^2$ $t = 4s$ $v_i = 0$

Req'd: $v_f = ?$, $y = ?$

a) $v_f = v_i + gt$

$= 0\ m/s - 9.8\ m/s^2\ (4s)$

$v_f = -39.2\ m/s$

(39.2 m/s downwards)

b) $y = \left(\frac{-39.2\ m/s + 0}{2}\right)(4s)$

$\boxed{y = -78.4\ m}$ downward

$y = \cancel{v_i t} + \frac{1}{2}gt^2$

$= \frac{1}{2}(-9.8\ m/s^2)(4s)^2$

$y = -78.4\ m$ //

Problem-Solving Strategy

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$$v_f^2 = v_o^2 + 2g\Delta y$$

Kinematic Examples (vertical)

A tennis ball is thrown straight up with an initial speed of 22.5 m/s. It is caught at the same distance above the ground.

a. How high does the ball rise?

b. How long does the ball remain in the air? Hint: The time it takes the ball to rise equals the time it takes to fall.

Problem-Solving Strategy

1. Identify **known values** of 3 variables. Write down; relate to the symbols.
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$$\Delta y = v_o t + \frac{1}{2}gt^2$$

$$v_f^2 = v_o^2 + 2g\Delta y$$

Try this!!!

1. Hawkeye shot an arrow is show straight up into the air and takes 6.50 s to come back down, what was the final velocity of the arrow? What was the initial velocity of the arrow?

2. Black Panther tossed the infinity stone upwards and reached a height of 11.5 m. What must be the initial velocity of the infinity stone?

3. Spiderman is furious about his costume being trash-like. He then throws a rock straight up into the air with an initial velocity of 15 m/s. How high in the air does the object go?

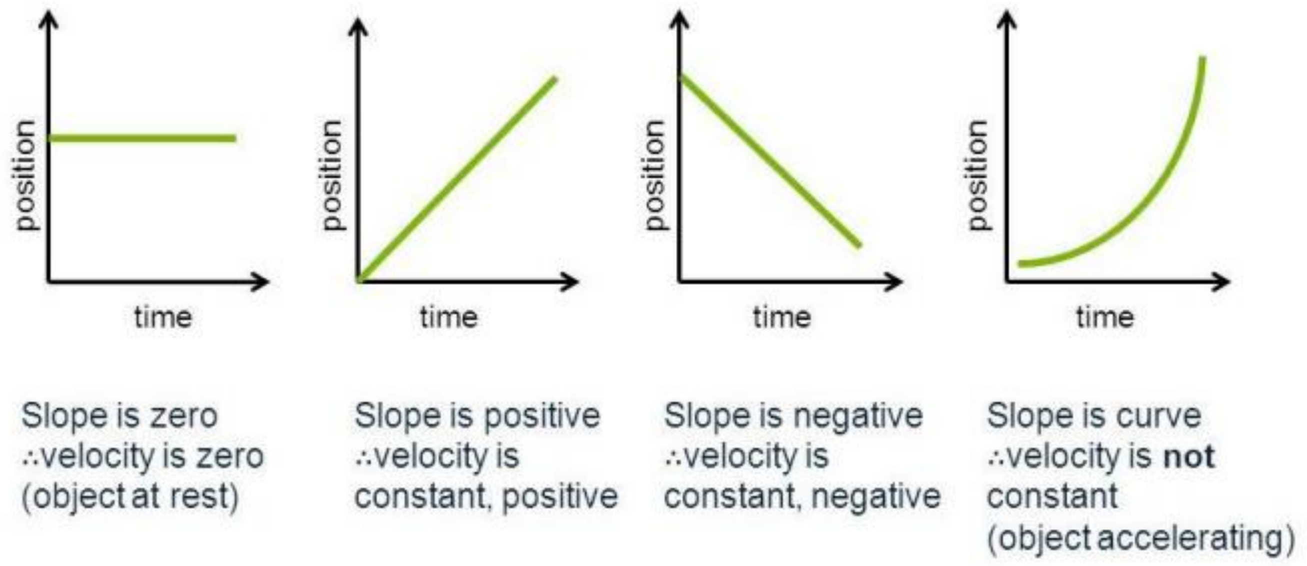
4. Gamora dropped a ball (Ball A) from a 150 m high tower with an initial velocity of 10 m/s. At the same time, Nebula tossed a ball (Ball B) from the ground upward at an unknown initial velocity. Find the value of the initial velocity of the Nebula's ball if the two balls meet at a height of 50 m above the ground.

Module 3: Motion in one dimension

3.3 Motion Graph

Position vs. Time Graph

- The position vs. time graph tells us the displacement of a moving object per time interval.
- We can get the average speed and average velocity from this.
- We can also get the instantaneous velocity of a moving object from this.



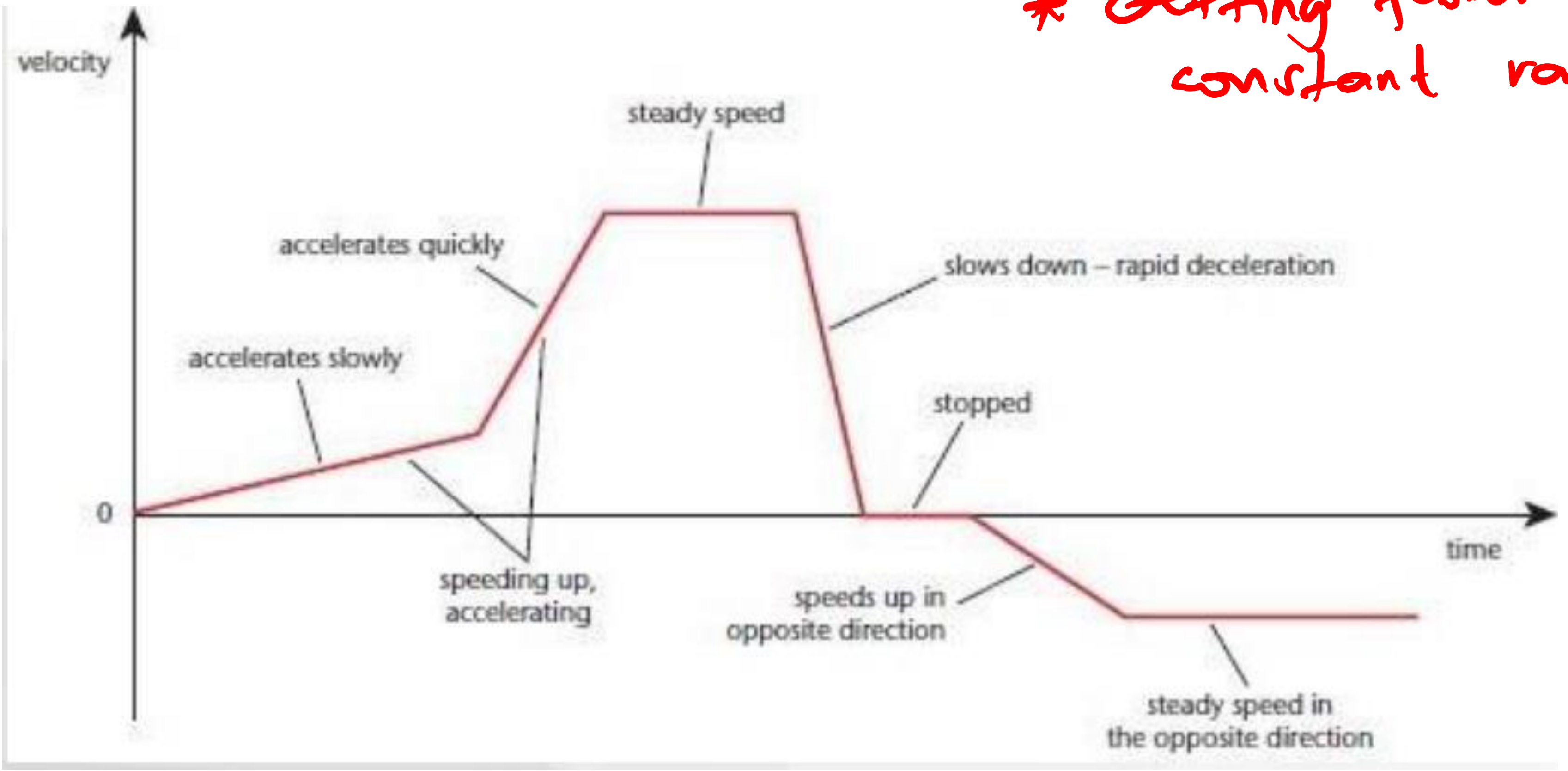
https://physics.stackexchange.com/questions/266043/position-velocity-acceleration-vs-time-graphs-when-falling-towards-a-black-h

TRY THIS
Prove that the slope of a position vs. time graph is equal to the velocity of the moving object.

* Going forward at constant rate.

Interpreting a Velocity vs. Time Graph

* Getting faster at a constant rate.



https://www.ck12.org/c/physics/velocity-vs-time-graphs/lesson/Velocity-Time-Graphs-MS-PS/

The graph on the right shows the position vs. time graph of your cute Physics prof walking along the hallways of FIT.

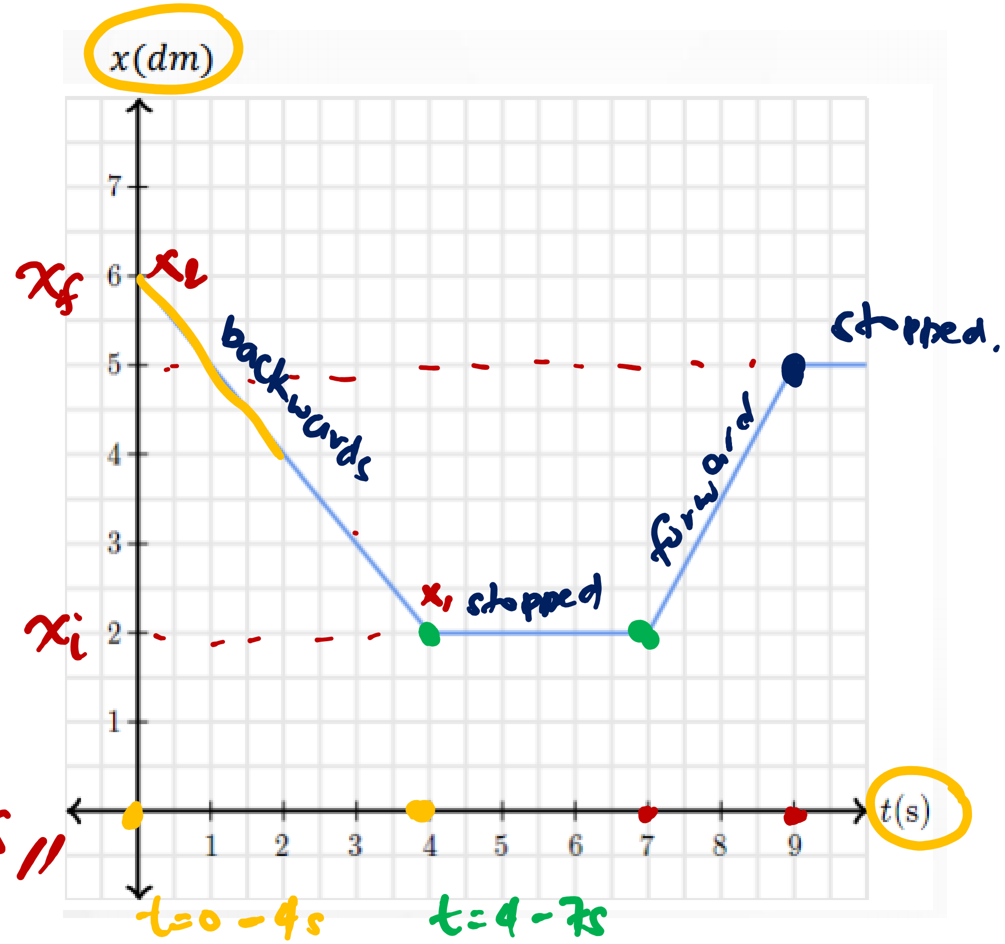
(a) At what time interval his velocity equal to zero?

(b) At what time interval he is moving forward?

(c) At what time interval he is moving backward?

(d) What is his instantaneous velocity at t = 4? 4?

(e) What is his instantaneous velocity at t = 9? 9?



a) at t=4 to t=7 & at t=9 to t=10s

b) at t=7 to t=9s

c) at t= 0 to t= 4s

d) $v = \frac{\Delta x}{\Delta t} = \frac{(x_f - x_i)}{t_f - t_o} = \frac{(x_i - x_f)}{t_f - t_i} = \frac{2-6}{4-0} = \frac{-4}{4} = -1\ dm/s$ //

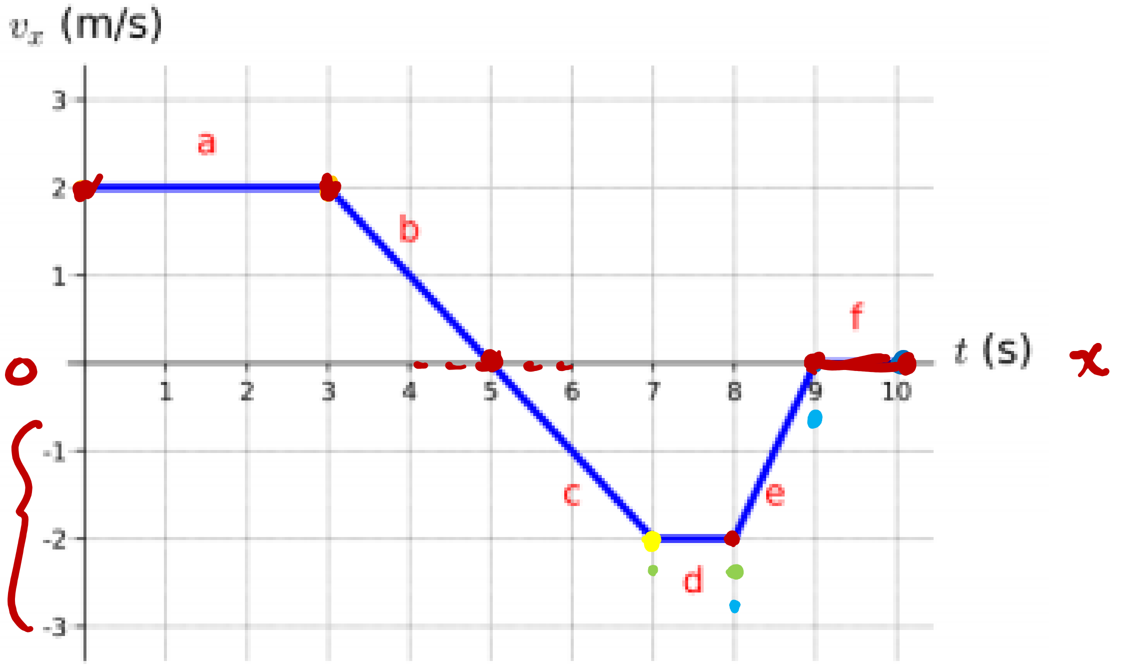
e) $v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{5-2}{9-7} = \frac{3}{2} = 1.5\ m/s$ //

Velocity vs. Time Graph

Problem 2. (Interpreting velocity versus time graph)

The figure on the right shows the velocity-versus-time graph for an object moving along the x-axis. During which segment (or segments) is

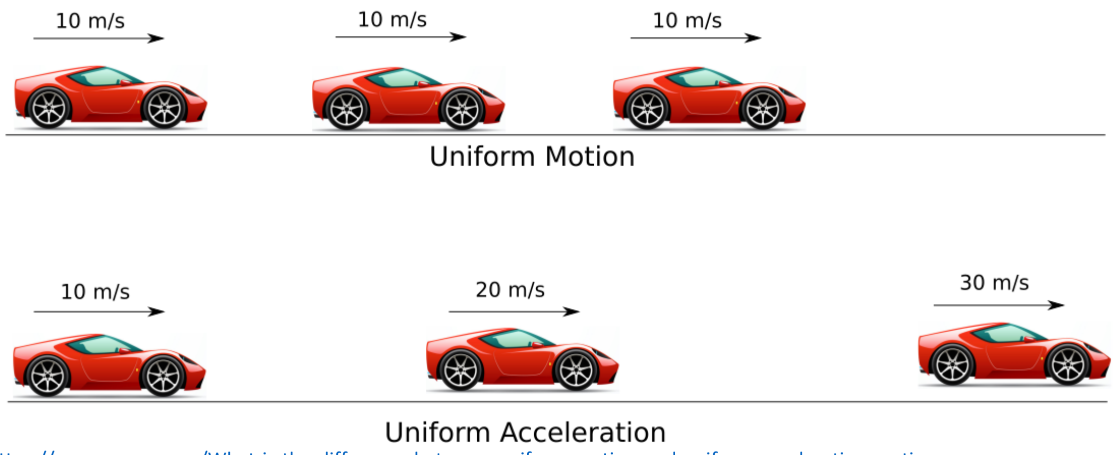
A. the object's velocity constant?
B. the object speeding up?
C. the object slowing down?
D. the object standing still?
E. the object moving to the right ($+x$-direction)?
F. the object moving to the left ($-x$-direction)?



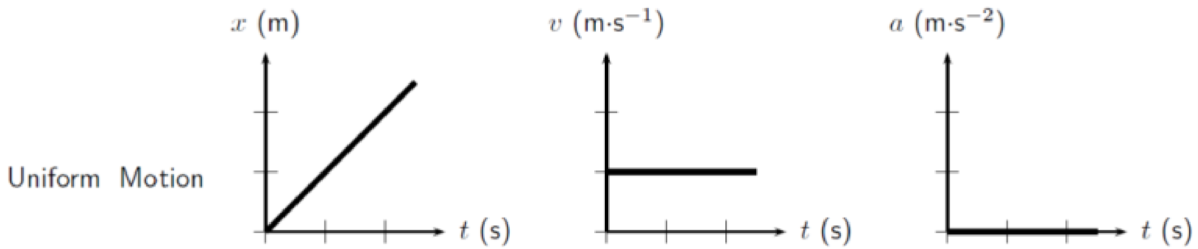
A.) segment a, d, f
B.) segment C → -velocity, moving oppositive
C) segment b & e →
D) Segment f (Velocity is exactly 0 m/s)
E) Segment a & b
F) segments c, d, e

Uniform Motion

- Uniform motion means that the object is moving with constant velocity.
- It means, the position vs. time graph of an object in uniform motion is perfectly linear.
- On the other hand, the velocity vs. time graph of an object in uniform motion is constant (horizontal line).



https://www.quora.com/What-is-the-difference-between-uniform-motion-and-uniform-acceleration-motion



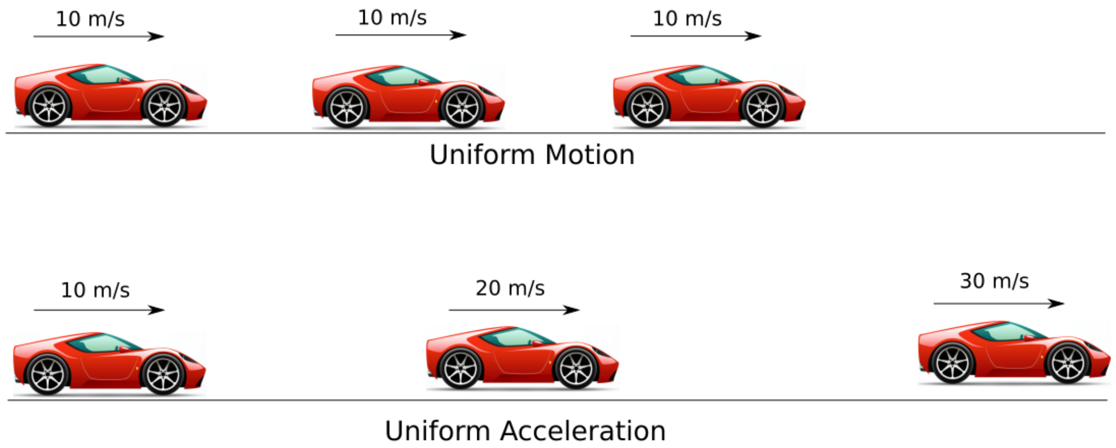
https://www.quora.com/What-is-the-difference-between-uniform-motion-and-uniform-acceleration-motion

Uniform Accelerated Motion

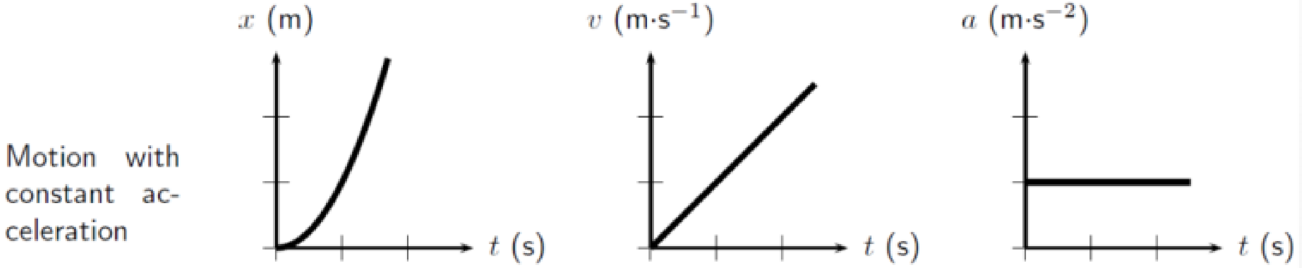
- Uniformly accelerated motion means that the object is moving with constant acceleration.
- It means, the position time graph of an object in UAM is exponential.

Curved line

- On the other hand, the velocity vs. time graph of an object in UAM is perfectly linear.



https://www.quora.com/What-is-the-difference-between-uniform-motion-and-uniform-acceleration-motion



https://www.quora.com/What-is-the-difference-between-uniform-motion-and-uniform-acceleration-motion

Module 3: Motion in one dimension

Got any questions???

References:

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The Physics Classroom (2020). Accessed at https://www.physicsclassroom.com