

Level 2

Objectives:

- Use all four kinematic equations interchangeably.

- For a given problem, write down given information and unknown information, and from this, select and solve the correct kinematic equation.

Name	Equation
Definition of Acceleration	$v_f = v_i + a \cdot \Delta t$
The King of Kinematic Equations	$\Delta x = v_i \cdot \Delta t + \frac{1}{2} a (\Delta t)^2$
The Average Velocity Formula	$\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t$
No-Time Equation	$v_f^2 = v_i^2 + 2a \cdot \Delta x$

Symbol	Quantity	SI Unit
$v_f$	Final velocity	m/s (meters per second)
$v_i$	Initial Velocity	m/s (meters per second)
$a$	Acceleration	m/s <sup>2</sup> (meters per second squared)
$\Delta t$	Change in time	s (seconds)
$\Delta x$	Displacement	m (meters)

**Introducing the 4 Kinematic Equations**

<b>Kinematics</b>
The study of how things <i>move</i> .
<b>4 kinematic equations</b>
These are four important equations that demonstrate how things <i>move</i> in physics.
<b>Condition for the kinematic equations</b>
You can use the kinematic equations when ever anything is moving with a <i>constant acceleration</i> . If acceleration is changing, you CANNOT use the kinematic equations.

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1. The study of motion is called \_\_\_\_\_.
2. Which kinematic equation have we already studied?
3. True or false: If my acceleration is changing, I can use the No-Time Equation.
4. True or false: If my acceleration is not changing, I can use The Average Velocity Formula.

*Formula 1*

Definition of Acceleration	$v_f = v_i + a \cdot \Delta t$
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**1.** I had an initial velocity of 8 m/s and now have a final velocity of 20 m/s. I have an acceleration of 4 m/s<sup>2</sup>. How much time did it take?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**2.** I had an initial velocity of 2 m/s and a final velocity of 23 m/s. I have an acceleration of 3m/s<sup>2</sup>. How much time did it take?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

*Formula 2*

The King of Kinematic Equations	$\Delta x = v_i \cdot \Delta t + \frac{1}{2}a(\Delta t)^2$
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3. When I travel with an acceleration of 5 m/s<sup>2</sup> for a time of 3 s, I travel a displacement of 69 m. What was my initial velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

4. When I travel with an acceleration of 7 m/s<sup>2</sup> for a time of 4 s, I travel a displacement of 104 m. What was my initial velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

5. I began with an initial velocity of 3 m/s and traveled for a time of 6 seconds. I eventually traveled a displacement of 126 m. What was my acceleration?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

6. I began with an initial velocity of 16 m/s and traveled for a time of 2 seconds. I eventually traveled a displacement of 50 m. What was my acceleration?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

Formula 3:

The Average Velocity Formula	$\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t$
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7. I begin with an initial velocity of 3 m/s and travel a displacement of 49 m in a time of 7 seconds. What is my final velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**8.** I begin with an initial velocity of 5 m/s and travel a displacement of 88 m in a time of 8 s. What is my final velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**9.** I travel a displacement of 90 m in a time of 5 seconds and end with a final velocity of 23 m/s. What was my initial velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**10.** I travel a displacement of 15 m in a time of 3 s and end with a final velocity of 9 m/s. What was my initial velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

*Formula 4:*

No-Time Equation	$v_f^2 = v_i^2 + 2a \cdot \Delta x$
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**11.** I begin with an initial velocity of 3 m/s and accelerate at a rate of 4 m/s<sup>2</sup>, while traveling a displacement of only 5 meters. What is my final velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**12.** I begin with an initial velocity of 2 m/s and accelerate at a rate of 2 m/s<sup>2</sup> while traveling a displacement of 8 m. What is my final velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**13.** I travel a displacement of only 4 meters while accelerating at a rate of 7 m/s<sup>2</sup>. If my final velocity is 9 m/s, what was my initial velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**14.** I travel a displacement of 6 m while accelerating at a rate of 3 m/s and end with a final velocity of 6 m/s. What was my initial velocity?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**15.** I begin with an initial velocity of 8 m/s and accelerate to a final velocity of 10 m/s. I traveled a displacement of 6 m, what was my acceleration?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**16.** I begin with an initial velocity of 6 m/s and slow down to a final velocity of 2 m/s. If I travel a displacement of 4 m, what was my acceleration?

[The answer should be *negative* here!]

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		



**17.** I begin with an initial velocity of 4 m/s and accelerate to a final velocity of 12 m/s. My acceleration was 2 m/s<sup>2</sup>. What displacement did I travel?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**18.** I begin at rest (initial velocity = 0 m/s) and accelerate at a rate of 4 m/s<sup>2</sup>. I finish with a final velocity of 20 m/s. What displacement did I travel?

Looking For	Formula	
Already Know		
Answer in a complete sentence <i>with unit</i> :		

**Answers:**

1. 3 s
2. 7 s
3. 15.5 m/s
4. 12 m/s
5. 6 m/s<sup>2</sup>
6. 9 m/s<sup>2</sup>
7. 11 m/s
8. 17 m/s
9. 13 m/s
10. 1 m/s
11. 7.0 m/s
12. 6.0 m/s
13. 5.0 m/s
14. 0
15. 3.0 m/s
16. - 4.0 m/s
17. 32.0 m
18. 50.0 m