Focused Learning Lesson
Science
Grades 9-12
PS-H-E2

Overview:
This lesson is designed to review the basic relationships of speed, velocity, and acceleration. During the lesson, students will review the definitions of speed, velocity, and acceleration, perform calculations of velocity and acceleration from a given set of data, and plot the results as a distance vs. time graph and a velocity vs. time graph. Review sheets, data sheets, prepared graph paper, and correct answers are included.

Approximate Duration: 45 minutes

Benchmark:
PS-H-E2 understanding the relationship of displacement, time, rate of motion, and rate of change of motion; representing rate and changes of motion mathematically and graphically

GLEs:
31. Differentiate between speed and velocity.
32. Plot and compare line graphs of acceleration and velocity.
33. Calculate velocity and acceleration using equations.

Benchmark:
SI-H-A3 using technology and mathematics to improve investigations and communications

SI GLE: 5. Utilize mathematics, organizational tools, and graphing skills to solve problems.

Objectives:
1. The student will define speed and velocity and their formulas.
2. The student will calculate velocity and acceleration using equations.
3. The student will plot and compare line graphs of velocity and acceleration.

Teacher Preparation:
The teacher should read all instructions before beginning and then make copies of the worksheets included for each student. See Attachment 1: Teacher Background.

Materials/Equipment/Resources:
- Copies of worksheets for each student.
- Pencil
- Calculators (optional)

Lesson Procedures:
Set or Opener:
The teacher can introduce the lesson with a discussion on what are the difference between speed, velocity, and acceleration and how do we illustrate the movement of an object. See Attachment 1, Teacher Background.

Body of the Lesson:

1. Begin with a review the basic definitions of speed, velocity, and acceleration. Allow for student questions and discussion. Use a toy car or a rolling ball to demonstrate each definition. See Attachment 2: Handout 1, Definitions.
2. Divide the class into groups of two or three and allow the students to complete Handout 2 (Attachment 4). Calculators are optional for this activity.
3. Instruct students to use their calculation results to plot on the appropriate graphs. See Attachment 3: Handout 2, the second page.
4. Instructed to answer the analysis section at the end of Handout 2, when they have completed the plotting their graphs.

Closure:

The teacher should now present the answers for the students to check their work. To present the answers, use a transparency and demonstrate of calculations. Attachment 5 may be used as a master for the transparency. Sample quiz questions are included in Attachment 6.

Attachments:

Attachment 1: Teachers Background
Attachment 2: Handout 1, Definitions
Attachment 3: Key to Handout 1
Attachment 4: Handout 2, Calculations and Graphing
Attachment 5: Key to Handout 2
Attachment 6: Sample Quiz

Sample Assessment Items:

Students' worksheets and plots may be used as assessment tools. Sample quiz questions are also provided in Attachment 6, Quiz.

Reference Links and Technology Connections:

The Physics Classroom. Available online at
http://www.physicsclassroom.com/Class/1DKin/U1L1d.html

Attachment 1
Teacher Background

Before the lesson, the teacher should prepare a copy of the handouts for each student.

At the beginning of the class, the teacher can introduce the lesson with such questions as:

1. How do we find out how fast we travel when we go from Baton Rouge to New Orleans, which is 50 miles away, in 1 hour?
2. What is the difference between speed and velocity?
3. What does it mean when we say accelerate?
4. Is there such a thing as negative acceleration?
5. If so, what is a negative acceleration?

For more information on speed, velocity, and acceleration and graphing, the teacher may want to see the following website for a tutorial:
www.physicsclassroom.com/Class/1DKin/U1L1d.html

This website may also be assigned as a follow-up for students.

Attachment 2
Handout 1: Definitions

DIRECTIONS: Fill in the blanks with the correct terms.

1. _____ is defined as the rate of motion or how fast an object moves.

2. To find speed, you must measure both distance traveled and the time it took to travel that distance and then use the formula:

$$\text{Speed (s)} = \frac{\text{(words)}}{\text{(words)}} = \frac{d}{t} \quad \text{(symbols)}$$

3. If distance is measured in meters and time is measure in seconds, then speed would have the units of measurement of _____.

4. Speed can also be determined from a _____ vs. _____ graph.

5. _____ describes both the speed and direction of a moving object.

6. Label the following units of measurement as <u>speed</u> or <u>velocity</u> units:

   a. 30 meters/second left _____ b. 25 km/hr East _____

   c. 45 meters/second _____ d. 6 miles/hour _____

7. Speed and velocity that does not change during an interval of time are said to be _____.

8. _____ speed (or velocity) is the speed (or velocity) at a particular moment in time.

9. _____ is a change in velocity during a amount of time; that is, a change in _____ or _____ or both.

10. Acceleration is calculated with the formula: (*supply the word formula)*

$$\text{Acceleration (a)} = \frac{\text{_____ - _____}}{\text{_____}} = \frac{V_f - V_i}{t}$$

11. Acceleration can be determined from a _____ vs. _____ graph.

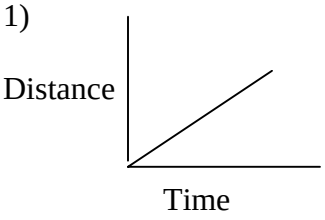
12. Acceleration that is increasing is aid to be _____.

13. Acceleration that is decreasing to said to be _____.

14. Identify the following graphs as:

A. Speed or Acceleration graph
B. Increasing or Decreasing

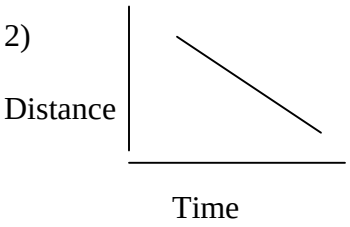
1)



A. _____

B. _____

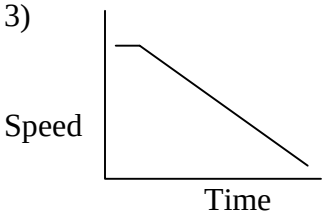
2)



A. _____

B. _____

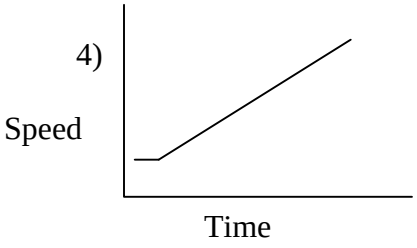
3)



A. _____

B. _____

4)



A. _____

B. _____

Attachment 3: Definitions
Handout 1: KEY

DIRECTIONS: Fill in the blanks with the correct terms.

1. *Speed* is defined as the rate of motion or how fast an object moves.

2. To find speed, you must measure both distance traveled and the time it took to travel that distance and then use the formula:

$$\text{Speed (s)} = \frac{\textit{Distance traveled}}{\textit{Time of}} = \frac{d}{t}$$

3. If distance is measured in meters and time is measure in seconds, then speed would have the units of measurement of *meters/seconds*.

4. Speed can also be determined from a *distance* vs. *time* graph.

5. *Velocity* describes both the speed and direction of a moving object

6. Label the following units of measurement as speed or velocity units:

   a. 30 meters/second left *velocity*

   b. 45 meters/second *speed*

   c. 25 km/hr East *velocity*

   d. 6 miles/hour *speed*

7. Speed and velocity that does not change during an interval of time are said to be *constant*.

8. *Instantaneous* speed (or velocity) is the speed (or velocity) at a particular moment in time.

9. *Acceleration* is a change in velocity during a amount of time; that is, a change in *speed* or *direction* both.

10. Acceleration is calculated with the formula:

$$\text{Acceleration (a)} = \frac{\textit{final velocity} - \textit{initial velocity}}{\textit{time}} = \frac{V_f - V_i}{t}$$

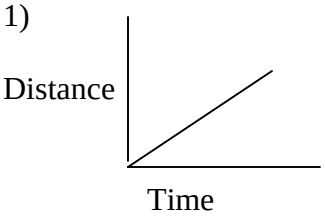
11. Acceleration can be determined from a *speed* vs. *time* graph.

12. Acceleration that is increasing is said to be *positive acceleration*.

13. Acceleration that is decreasing to said to be *negative acceleration*.

14. Identify the following graphs as:
    A. Speed or Acceleration
    B. Increasing or Decreasing

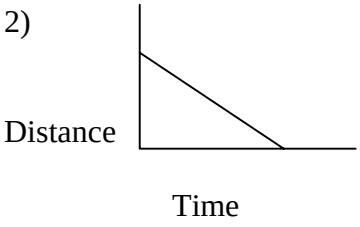
1)



A. *speed*

B. *increasing*

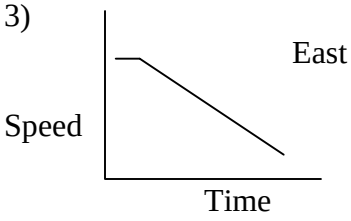
2)



A. *speed*

B. *decreasing*

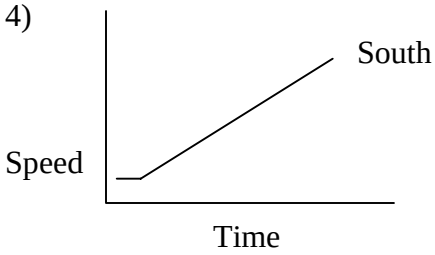
3)



A. *acceleration*

B. *decreasing*

4)



A. *acceleration*

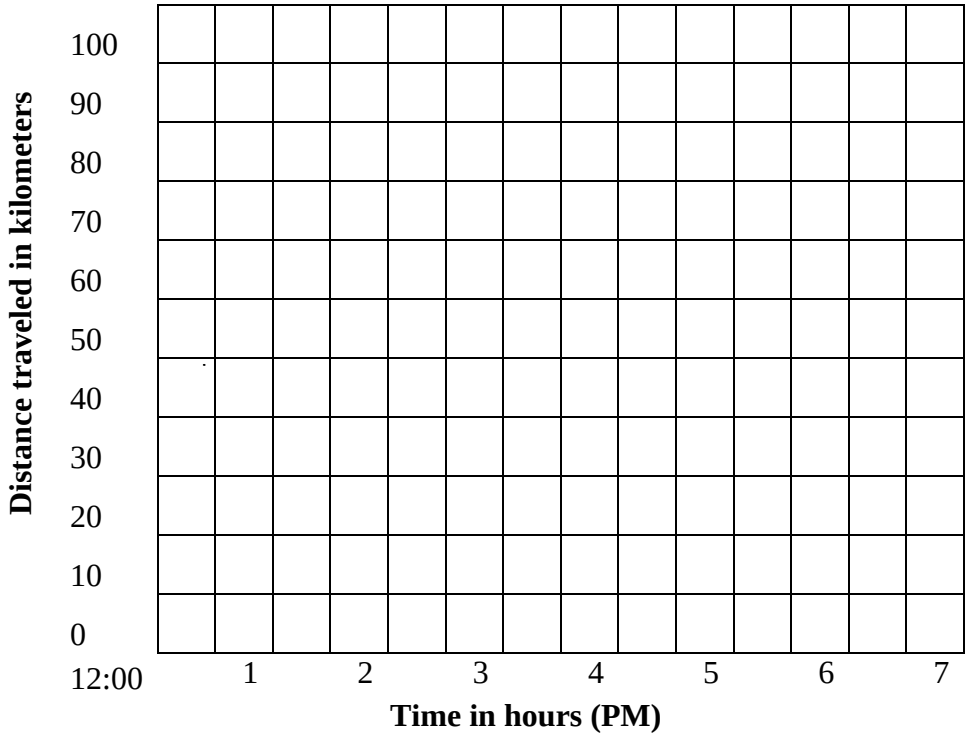
B. *increasing*

Attachment 4: Calculations and Graphs
Handout 2

Sam went riding with some friends one afternoon. They kept a chart of their journey of how far they traveled after certain times. The data chart is presented below. Using this information, plot (graph) their journey on the distance vs. time graph and answer the questions below.

Distance traveled (kilometers)	0	10	40	70	90	100
Time (hours)	12:00 noon	1:00	2:00	3:00	4:00	5:00

Graph of Distance vs. Time



Questions to consider:

1. What was the average speed over their entire journey? _____

2. Between which hours were they going the fastest speed? _____

3. What was their speed at 2:30 PM? _____

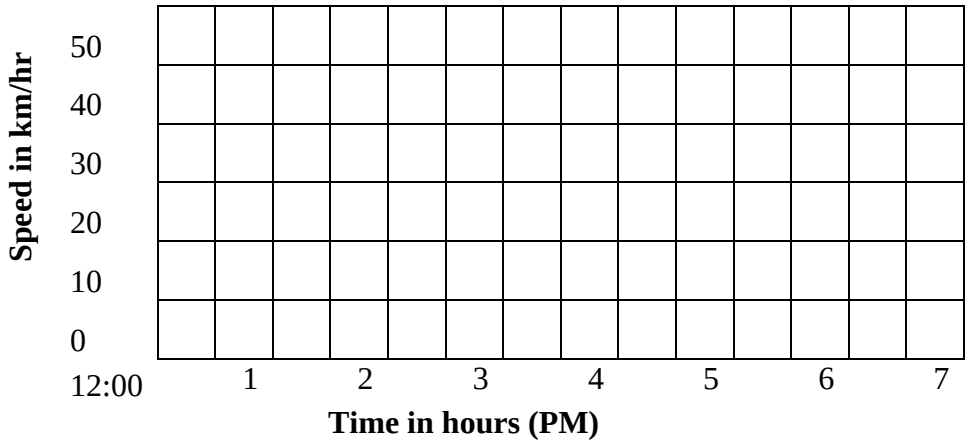
4. Are they traveling at a constant speed during their journey? _____

Directions: Using the distance and times for their journey,

1. calculate the **speed** and **acceleration** for each hour (show your work),
2. plot the acceleration on a speed vs. time graph below, and
3. answer the questions below.

Time (hours)	Distance (kilometers	Speed (km/hr)	Acceleration (km/hr/hr)
0	0	0	0
1	10		
2	40		
3	70		
4	90		
5	100		

Graph of Speed vs. Time



Questions to consider:

1. Was there a constant acceleration during the journey? Explain your answer.

   _____

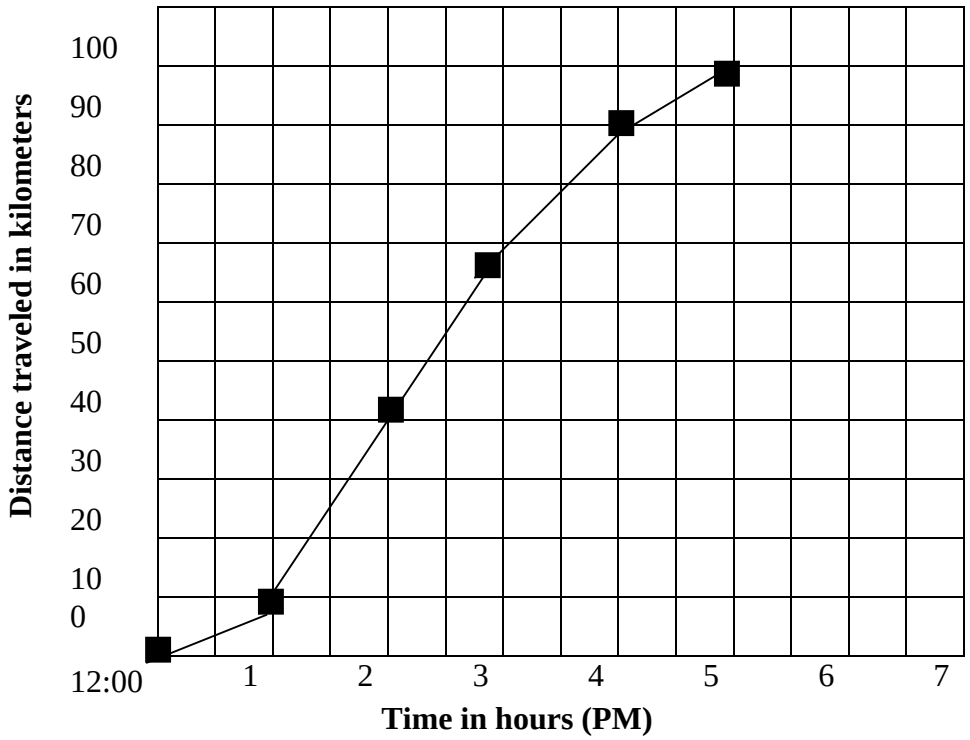
2. When was there a positive acceleration? _____
3. When were they traveling at a constant speed? _____
4. When were they going at a negative acceleration? _____
5. When they positively accelerate the greatest? _____

Attachment 5: Calculations and Graphs
Handout 2: Key

Sam went riding with some friends one afternoon. They kept a chart of their journey of how far they traveled after certain times. The data chart is presented below. Using this information, plot (graph) their journey on the distance vs. time graph and answer the questions below.

Distance traveled (kilometers)	0	10	40	70	90	100
Time (hours)	12:00 noon	1:00	2:00	3:00	4:00	5:00

Graph of Distance vs. Time



Questions to consider:

1. What was the average speed over their entire journey? *100 km /5 hr = 20 km/hr*

2. Between which hours were they going the fastest speed? *Between 1:00 and 3:00*

3. What was their speed at 2:30 pm? *55 km/hr*

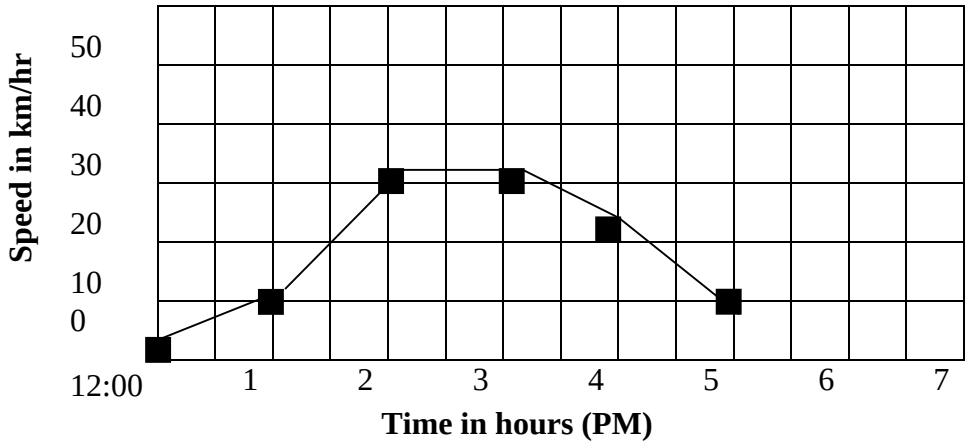
4. Are they traveling at a constant speed during their journey? *No*

Directions: Using the distance and times for their journey,

- calculate the **speed** and **acceleration** for each hour (show your work),
- plot the acceleration on a speed vs. time graph below, and
- answer the questions below.

Time (hours)	Distance (kilometers	Speed (km/hr)	Acceleration (km/hr/hr)
0	0	0	0
1	10	10/1 = 10	(10-0)/1= 10
2	40	30/1=30	(30-10)/1= 20
3	70	30/1=30	(30-30)/1= 0
4	90	20/1=20	(20-30)/1 = -10
5	100	10/1=10	(10-20)/1 = -10

Graph of Speed vs. Time



Questions to consider:

6. Was there a constant acceleration during the journey? Explain your answer.
   No, the line is not straight.

7. When was there a positive acceleration? *between 12:00 and 2:00 PM*

8. When were they traveling at a constant speed? *between 2:00 and 3:00 PM*

9. When were they going at a negative acceleration? *After 3:00 PM*

10. When was positive acceleration the greatest? *between 1:00 and 2:00 PM*

Attachment 6
Sample Quiz

Multiple Choice

1. The velocity of an object tells
   - A. speed.
   - B. direction.
   - C. speed and direction.
   - D. speed, direction, and acceleration.

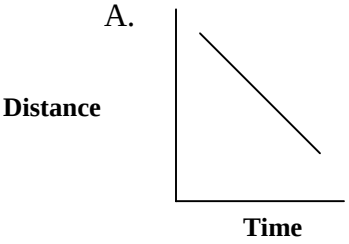
Calculation

2. John rides his bike for 20 miles in 4 hours. What is his speed?
   Show calculations here.

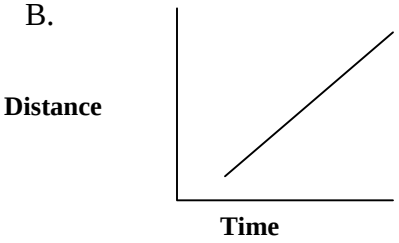
Graphing

3. Which of the following graphs shows an object that is at constant speed?

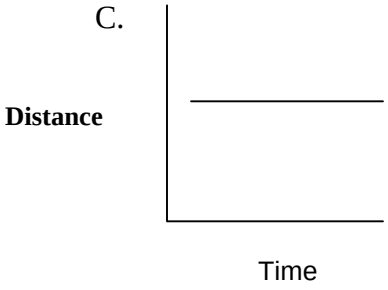
A.



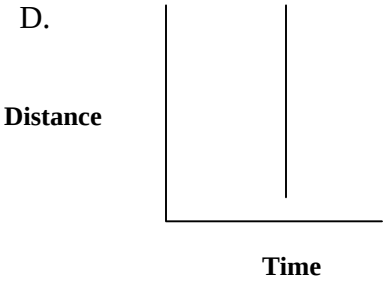
B.



C.



D.



Short Answer

4. Compare and contrast velocity and acceleration.

Key:

1. - C, 2. - 5 miles/hour, 3. – C, and 4. - Velocity is how fast an object is moving while accelerating is how fast the velocity is changing.