

Motion and Time SUMMARY SHEET

Learner Previous Knowledge

Measurement of distance ;Motion-periodic, circular and straight

Target Knowledge for this Topic

Motion; Speed-Average speed

Measurement of Time-Time period, pendulum

Units of Time and Speed

Measuring Speed

Distance-Time Graphs-How to plot graphs and learn about their uses

Learning Goals

More Complex Learning Goal- Students will be able to infer information of speed/distance/time from a given graph.

Target Learning Goal- Students will be able to explain speed, time period, find out the quantities from the given data and plot graph from given data.

Simpler Learning Goal- Students will be able to state how to find speed, define time period and plot a simple distance-time graph.

Period No.
Lesson Objectives
Teaching Learning Materials Required

1

- Deduce concept of uniform and non-uniform motion and explain what is speed

- Board and markers
- Worksheet 1
- Reference sheet 1
- Chalk to mark position on ground and stop watch

2

- Demonstrate and explain the concept of time period.

- Board and markers
- Worksheet 2
- Reference sheet 2
- Activity: Stop watch, pendulum, stand to hang pendulum and string (for each group)

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3	Explain units of measurement of time and speed and deduce which unit is most appropriate for measuring time of different phenomena.	- Board and markers - Worksheet 3
4	Measure and calculate speed of different objects.	- Board and markers - Worksheet 4 - Activity (for each group): Ball, chalk, stop watch, measuring tape
5	Explain different types of graphs and plot a graph.	- Board and markers - Reference sheet 3 - Graph paper, ruler, sharp pencil (for each student)
6	Deduce uses of graph and plot graphs based on given data.	- Board and markers - Worksheet 6

Period 1

Lesson Objectives

At the end of this lesson students will be able to:

- Deduce concept of uniform and non-uniform motion and explain what is speed

Teaching Learning Materials required

- Board and markers
- Worksheet 1
- Reference sheet 1
- Chalk to mark position on ground and stop watch

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4 or 5 outside in the garden

Lesson Beginning <u>Time:</u> 5 min <u>Purpose:</u> • Activate the prior knowledge	<u>Introduction of Topic</u> • Introduce the topic by asking students what they understand by linear motion or circular motion. Pose questions such as: ○ If a stone tied to a string is swung round and round, what kind of motion is it? ○ What exactly do you understand by motion? ○ Does a bee show linear motion or random motion? ○ If two cars are travelling in the same direction and suddenly one of them goes ahead of the other, which car's speed will be less? ○ If a bus and a bicycle start their journey at the same time, after five minutes you will realize that the cycle has less speed than the bus. Why do you say so? On what basis have you said this? ○ What do you mean when you say that the speed of the car was 50 km per hour? • Collect all the answers and arrive at a consensus. • Arrive at a consensus that to compare speed of two moving objects, we can find out the distance moved by them in unit time. More the distance covered in unit time, more is the speed. • Inform the students that they will now learn more about motion and learn about the concept of speed.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u>	<u>Activity</u> • Distribute Annexure 1 A to all the students. • Each group must select 2-3 members and ask them to run a distance of 20 meters. • Let one of the members time them.

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Develop conceptual understanding	- Now each group must attempt the questions asked in the annexure. - Let there be a class discussion, in which all the answers of the annexures will be discussed. Ensure that all students are on the same page.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish up	<u>Finish Up</u> - Summarize the concept with the help of reference sheet 1. - Clear doubts of the students.

Worksheet 1

Skill: Drawing Inferences

Activity

*** Speed=Distance/Time**

Since a vehicle does not move with constant speed we consider the total distance covered and the total time taken. This gives us average speed. Thus,

$$\text{Speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

Instruction

1. Mark the starting point and finishing point with a chalk.
2. Let two members of your group run the distance.
3. One of the members can time them with a stop watch while another one can observe who has reached the finishing line first.
4. Collect the data and fill the table.

*Measure the speed in metres per second

Name of the student	Distance covered-20 metres	Time taken (s)	Speed=Distance/Time

Questions:

1. Whose speed was greater?

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2. In the above case, on what basis did you decide whose speed was less?

3. What do you think should be the unit of speed in the above activity? _____

4. Do you use the same unit to measure speed of car as you used here? Why?

II. The meaning of uniform is unchanging or constant. When a person drives a car from his home to his office, do you think he drives in uniform motion? Why?

III. Non-uniform means changing or uneven. Now, decide whether the person driving a car from home to office demonstrates uniform motion or non-uniform motion. Based on this example, decide which of the following demonstrate uniform or non-uniform motion.

1. Earth travelling around Sun _____

2. Ferrari driving on the highway _____

3. Toy-train moving on toy tracks _____

4. Bullock cart on road _____.

Now, in your own words define uniform and non-uniform motion.

Uniform Motion: _____

Non- Uniform Motion: _____

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Reference sheet 1

Information

- Distance covered by an object in unit time is called speed.
- Vehicles do not move with constant speed. Hence, we consider total distance covered by it in one hour.
- The units of the speed can be km/hr or m/s
- The speed actually calculated for vehicles is its average speed.
- So, the formula of speed can be:

$$\text{Speed} = \frac{\text{Total Distance covered}}{\text{Total time taken}}$$

- If the speed of an object keeps on changing constantly, it is said to be in non-uniform motion.
- If the speed of an object is constant, it is said to be in uniform motion.

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Period 2

Lesson Objectives

At the end of this lesson students will be able to:

- Demonstrate and explain the concept of time period.

Teaching Learning Materials required

- Board and markers
- Worksheet 2
- Reference sheet 2
- Activity: Stop watch, pendulum, stand to hang pendulum and string (for each group)

Details of Teaching Learning Experience

Seating Arrangement: In groups of 4-5

Lesson Beginning <u>Time:</u> 5 min <u>Purpose:</u> • Activate prior knowledge.	<u>Introduction to topic</u> • Let them recap the definitions of uniform/non-uniform motions. • Now pose questions such as: ○ List a few processes, which occur naturally with regularity such as sunrise. ○ What is the length of these processes? [For example, if a student says season then what is the approximate time for which a season lasts?] ○ How do we measure time interval of a day, month or year? ○ If you observe a wrist watch, which actions appear to repeat over and over again? ○ Does a pendulum of a clock change its speed while swinging to and fro? • Collate all responses and arrive at the consensus that there are different ways of measuring time interval for different activities or phenomena. • Now write the two words 'Uniform' and 'Periodic' on the board. Ask the students that, if they have to select a name for the motions/phenomena that they discussed right now, which of the two is most appropriate? • Arrive at the answer 'Periodic'. • Inform the students that they will now do an activity to find out how much time a pendulum takes to swing from its resting position.
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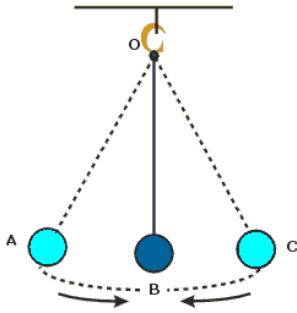
Lesson Middle <u>Time:</u> 20 min. <u>Purpose:</u> Develop conceptual understanding	<u>Activity</u> - Distribute worksheet 2. - Let the groups do the activities. - Let them attempt questions based on the observation. - There can now be a whole class discussion in which the reasons and analysis made by the groups for given cases is shared. - Ensure that the whole class is on the same page with respect to the answers.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish Up	<u>Finish Up</u> - Summarize the concept taught with the help of reference sheet 2. - First, clear doubts if the students have.

Worksheet 2**Skill: Observation and Investigation****Activity 1**

Material: string, pendulum, stand to hang the pendulum, stopwatch

Instructions

- Set up a pendulum as shown in the picture.
- Switch off fans.
- Let the pendulum be at rest. This is the mean position.
- Mark its position on the table or on the floor under it.
- To set the pendulum in motion, gently hold the bob and move it slightly to one side ensuring that the string is taut and not sagging while you do so.
- Now release the pendulum.
- Note the time when the pendulum reaches any one extremes.
- Measure time taken by the pendulum to complete 20 oscillations and record it. Fill the observation table I. Repeat this activity a few times and then repeat it for different number of oscillations. For the latter, fill the second observation table.



* Time taken to complete one oscillation is called **time period**. In the activity, to find time period, divide the time taken for 20 oscillations with 20.

Observation Table I

Sr. No.	Time taken for 20 oscillations [s]	Time Period= Time taken/No. of oscillations

Observation Table II

Sr. No.	No of oscillations	Time taken for oscillations [s]	Time Period= Time taken/No. of oscillations
1	30		
2	40		
3	50		

Questions:

1. What was the average time period of the pendulum for 20 oscillations?

2. What specific aspect did you observe in the time period recorded in the second table?

3. Is the period of oscillation same or different for different numbers of oscillations?

4. What conclusions can you draw from this experiment?

Reference sheet 2**Information**

1. Motion, which occurs periodically and regularly, are called periodic motion. Wristwatches, [or any kind of watch], pendulum etc. exhibit periodic motion.
2. Time taken by a pendulum to complete one oscillation is called its **time period**.
3. Irrespective of number of oscillations that you measure [as in activity 1], the time period for a given length of a pendulum remains the same.
4. Increase in length of the pendulum results in increase in its time period.

Lesson Plan 3

Lesson Objectives

At the end of this lesson students will be able to:

- Explain units of measurement of time and speed and deduce which unit is most appropriate for measuring time of different phenomena.

Teaching Learning Materials required

- Board and markers
- Worksheet 3

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4-5

Lesson Beginning <u>Time:</u> 5 min. <u>Purpose:</u> Introduce the topic	<u>Whole Class Discussion</u> • Ask the students to recap how speed is calculated and how time period is calculated. • Now ask them to predict what can be the units to measure speed and time. Pose questions such as: ○ Can the same unit of time be used to measure different quantities? ○ For example, can we use seconds to measure any time interval? ○ Can speed be measured in the same quantity for every type of motion? ○ For example, can we measure the speed of a car and a toy care using same unit? • Collect all the answers and write the predicted unit of time and speed on the board. • Inform the students that they will now make a sand clock. They will then conclude which units are most appropriate for measuring speed of different objects and time interval of various phenomena.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u> Develop conceptual understanding	• Distribute worksheet 3 to all students. • Let the students attempt the worksheet after which a group discussion should take place in which they conclude the appropriateness of time intervals for various phenomena. • Let them attempt the questions. • Let there be a whole class discussion now.

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	• Arrive at a common consensus.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish Up	<u>Finish Up</u> • Wrap the class by clearing doubts.

Worksheet 3

Skill: Comprehension

* Speed is usually measured in km/s or m/s but the basic unit of time is considered as m/s.

** Unit of time is usually second (s) but the unit depends on the need.

1. Which unit is best suited to find the speed of your school bus?

- i. m/min
- ii. km/h
- iii. m/s

2. Why don't we use months to express your age?

3. How many seconds are there in a day?

4. How many hours are there in a year?

5. Which of the following is incorrect?

- i. $\text{Speed} = \text{Distance} / \text{Time}$
- ii. $\text{Distance} = \text{Speed} \times \text{Time}$
- iii. $\text{Speed} = \text{Time} / \text{Distance}$

6. What will happen if we measure time only in seconds and no other units? What problems will we face? Explain with examples.

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Period 4

Lesson Objectives

At the end of this lesson students will be able to:

- Measure and calculate speed of different objects.

Teaching Learning Materials required

- Board and markers
- Worksheet 4
- Activity (for each group): Ball, chalk, stop watch, measuring tape

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4-5 outside in playground

Lesson Beginning <u>Time:</u> 5 min. <u>Purpose:</u> Introduce the topic	<u>Activity Instructions</u> • Ask the students to recap how time is measured. • Now ask the students what are the units of speed that are commonly used. • Inform them that they will now do activity to calculate speed. • Distribute worksheet 4 to all the students and let them go to the playground. They will continue working in groups.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u> Develop conceptual understanding	<u>Activity</u> • Let the groups do the activity as per instructions. • Let them attempt the questions. • Let there be a whole class discussion now. • Arrive at a common consensus.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish Up	<u>Finish Up</u> • Wrap the class by clearing doubts. <u>Homework Assignment</u> • Find out information about speedometer and odometer. • Find out the meaning of graph from the textbook or from an encyclopedia or the internet.

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Worksheet 4

Skill: Comprehension

Activity

Material: Ball, chalk, stop watch, measuring tape

Instruction

1. Draw a straight line with chalk on the ground.
2. Let one student stand at a short distance of 2-3 m away.
3. Roll a ball gently from the opposite side of the marked line.
4. Note the time taken by the ball to cross the line.
5. Also note the time when it comes to rest.
6. Measure the distance between the point at which ball crosses the line and where it comes to rest.
7. Record the measurements and then calculate the speed of the ball.
8. Repeat this for different distances.

Distance moved by the ball (m)	Time taken (h)	Speed= Distance/Time taken (m/s)

Questions

1. Will you be able to calculate speed of the ball without a stopwatch? _____
2. A ball travels at a speed of 4m/s in 1 minute. Can you calculate the distance from the given data?
*Hint: Speed=D/T

3. A toy car travels 2 m at a speed of 2m/s. What is the time taken by it to travel that distance?

4. Select the correct answer for converting km/h into m/s.

- a) multiply the given quantity by $1\text{km/h}=1000\text{m}/3600\text{ s}$ [because $1\text{ km}=1000\text{m}$ & $1\text{ hour}=3600\text{ seconds}$]
- b) multiply the given quantity by $1\text{km/h}=1000\text{m}/1800\text{ s}$ [because $1\text{ km}=1000\text{m}$ & $1\text{ hour}=1800\text{ seconds}$]
- c) multiply the given quantity by $1\text{km/h}=100\text{m}/3600\text{ s}$ [because $1\text{ km}=100\text{m}$ & $1\text{ hour}=3600\text{ seconds}$]

5. A train covers a distance of 1000km in 10 hours. What is its speed in m/s?

6. A cycle first moves at 20km/h for 10 minutes and then 10km/h for 10 minutes. What is the total distance covered by it? Find distance covered in each case.

7. Sid's father uses his scooter to go to the office. If he covers 12 km distance at a speed of 36km/h, what is the time taken by him to reach his office?

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Period 5

Lesson Objectives

At the end of this lesson students will be able to:

- Explain different types of graphs and plot a graph.

Teaching Learning Materials required

- Board and markers
- Reference sheet 2
- Graph paper, ruler, sharp pencil (for each student)

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4-5

Lesson Beginning <u>Time:</u> 5 min. <u>Purpose:</u> Introduce the topic	<u>Introducing the topic</u> • Ask the students to explain the meaning of speedometer and odometer and where are they used, as per the homework given in the previous class. • Now pose the following questions: ○ Do you know what a graph is? ○ Have you heard of a pie graph or a bar graph? ○ How many quantities do you think we need to make a graph? • Arrive at a consensus that graph is a representation to show link between two quantities either by a line or a bar or a part of a circle in pie graph. • Inform the students that they will now learn how to plot a graph.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u> Develop conceptual understanding	<u>Plotting a Graph</u> • Distribute worksheet 5 to all students. • Let the groups follow the instructions and ask each student to individually plot the graph using the data given in question 1 of the worksheet. • Help the students if needed.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u>	<u>Finish Up</u> • Wrap the class by clearing doubts.

- Finish Up

Reference sheet 2

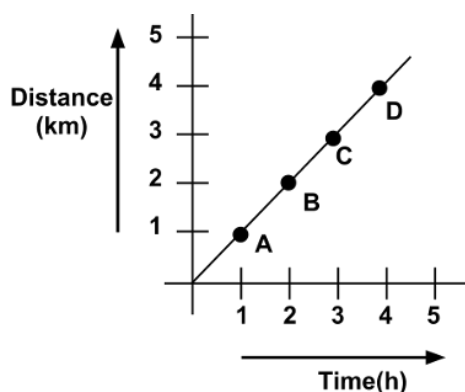
How to draw a graph?

* In a line graph, the points on a line graph are connected by a line. A line graph is useful in displaying data or information that changes continuously over time.

** Data for the total distance moved at different times during movement can be in a graph. This graph is called Distance Time graph.

Instructions to plot a graph

1. On a graph paper draw a horizontal line and mark it as XX'. It is the X-axis.
2. Similarly draw a perpendicular vertical line and mark it as YY'. It should look as the picture given below. It is the Y-axis.
3. The point of intersection of x-axis and y-axis is the origin O.
4. In a distance-time graph, time usually runs horizontally and distance runs vertically.
5. Choose a scale. For example, distance: 1km=1 cm and time: 1min=1 cm
6. Mark values on the x-axis as per the scale i.e. 1 h, 2 h, 3 h. etc. Similarly mark distance on y-axis: 1km, 2 km, 3km and so on.
7. Now mark the points to represent each set of values. After 1 h, the car has moved 1 km. To mark this set of values, look for the point that represents 1 h on the x-axis. Draw a line parallel to y-axis at this point.
8. Then draw a line parallel to the x-axis from the point corresponding to distance 1 km on the y-axis. The point where these two lines intersect represents this set of values. [As seen in the picture, represented by points of intersection A, B, C and so on.]



9. B shows distance covered in 2 h, C shows distance covered in 3 h and so on.

10. Join all the points and you will find that it is a straight line.

Information

- If a distance-time graph is a straight line, it means that the object is moving with constant speed.
- Choose the scale sensibly. For example, if you have to plot a graph where distance covered is 100km then a scale of 1km=1cm is not suitable, as you will have to plot an 80 cm y-axis. Instead choose a more appropriate scale such as 10km=1cm. This will require a 10 cm y-axis only.
- Observe the highest and lowest values to choose a correct scale.
- Try to utilize maximum part of the paper.

Ques1. Draw a distance time line graph for the following data.

S. No.	Time (s)	Distance m
1	0	0
2	4	100
3	8	250
4	10	300
5	14	500

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Period 6

Lesson Objectives

At the end of this lesson students will be able to:

- Read a graph and comprehend it.

Teaching Learning Materials required

- Board and markers
- Worksheet 6

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4-5

Lesson Beginning <u>Time:</u> 5 min. <u>Purpose:</u> Introduce the topic	• Ask the students to share their understanding about graphs. • Inform the students that they will now plot a graph for the given data.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u> Develop conceptual understanding	• Distribute worksheet 6 to each group. • Ask the students to observe the graph in it and answer the questions below. • Let the students read the graphs and answer questions. • Help them if required. • Let there be a whole class discussion now. • Arrive at a common consensus.

Lesson EndTime: 5 minPurpose:

- Finish Up

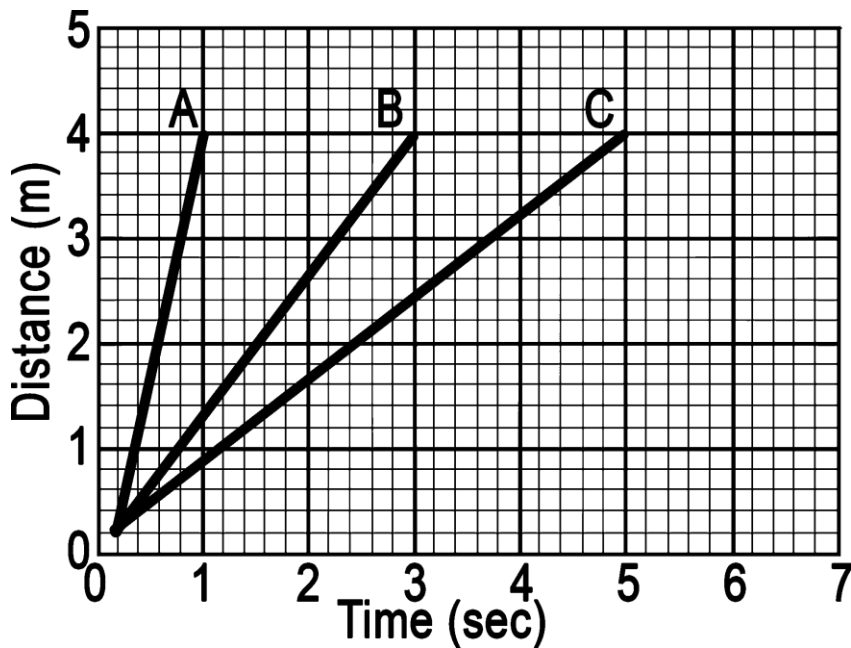
Finish Up

- Wrap the class by clearing doubts.

Worksheet 6**Skill: Observation and Comprehension**

Observe the graphs and answer the questions:

I.

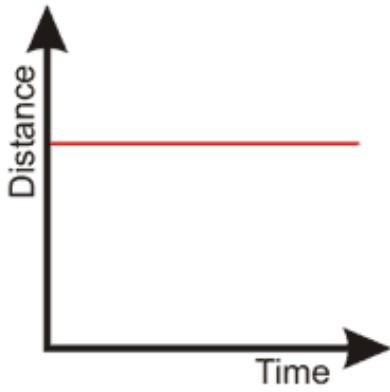


1. How many vehicles are travelling, from the same point, according to this graph?

2. Which vehicle's speed will be the fastest? _____

3. Which vehicle is taking more time to reach the same distance of 4 meters? _____

4. What is the time taken by B to cover 4 m? _____



II.

1. Is the object moving (as per the above graph)? _____
2. What will be the speed of the object? _____