NCERT CLASS 7 SCIENCE

CHAPTER 8 : MEASUREMENT OF TIME AND MOTION

In Text Questions & Answers

1 InText Question 1 (Page 106)

Q. How was time measured when there were no clocks and watches?

Ans. Before the invention of modern clocks and watches, time was measured using natural repeating cycles (such as the rising and setting of the Sun, phases of the Moon, and changing seasons) and early devices like sundials, water clocks, hourglasses, and candle clocks.

2 InText Question 2 (Page 112)

Q. For races covering the same distance, we can tell who was faster by measuring time. But how can we tell that when comparing races for different distances?

Ans. When comparing races over different distances, we determine who is faster by calculating the speed of each runner. Speed is the distance covered divided by the time taken (Speed = $\frac{\text{Distance}}{\text{Time}}$ / Time). The person with the higher speed is faster, regardless of distance.

3 InText Question 3 (Page 116)

Q. I once watched a part of marathon on a straight road stretch. I noticed that some people seemed to be running at the same speed during that distance while some people would speed up or slow down. How were their motion different?

Ans. People running at a constant speed along a straight road are executing uniform linear motion (covering equal distances in equal intervals of time). Those who speed up or slow down are executing non-uniform linear motion (covering unequal distances in equal intervals of time).

Let Us Enhance Our Learning — Exercise Solutions

1 Calculate the speed of a car that travels 150 metres in 10 seconds. Express your answer in km/h.

Ans. Given: Distance = 150 m, Time = 10 s

Speed in m/s = $\frac{\text{Distance}}{\text{Time}} = \frac{150}{10} = 15$ m/s

To convert m/s to km/h, multiply by 18/5:

Speed in km/h = $15 \times \frac{18}{5}$ = **54 km/h**

2 A runner completes 400 metres in 50 seconds. Another runner completes the same distance in 45 seconds. Who has a greater speed and by how much?

Ans. Runner 1: Speed = $\frac{400}{50} = 8$ m/s

Runner 2: Speed = $\frac{400}{45} = 8.89$ m/s

Difference: 8.89 − 8 = 0.89 m/s

Runner 2 has a greater speed by 0.89 m/s.

3 A train travels at a speed of 25 m/s and covers a distance of 360 km. How much time does it take?

Ans. Convert speed to km/h:

Speed = $25 \times \frac{18}{5} = 90$ km/h

Time taken = $\frac{\text{Distance}}{\text{Speed}} = \frac{360}{90}$ = **4 hours**

4 A train travels 180 km in 3 h. Find its speed in: (i) km/h, (ii) m/s, (iii) What distance will it travel in 4 h if it maintains the same speed throughout the journey?

Ans. (i) Speed in km/h = $\frac{180}{3} = 60$ km/h

(ii) Speed in m/s = $60 \times \frac{5}{18} = \frac{50}{3} \approx 16.67$ m/s

(iii) Distance in 4 hours = 60 km/h × 4 h = **240 km**

5 The fastest galloping horse can reach the speed of approximately 18 m/s. How does this compare to the speed of a train moving at 72 km/h?

Ans. Convert train's speed to m/s:

Train speed = $72 \times \frac{5}{18} = 20$ m/s

Comparing both: The train (20 m/s) is faster than the horse (18 m/s) by **2 m/s.**

6 Distinguish between uniform and non-uniform motion using the example of a car moving on a straight highway with no traffic and a car moving in city traffic.

Ans.
- Car on straight highway without traffic: Demonstrates uniform linear motion because it can maintain a constant speed along a straight path over equal time intervals.
- Car in city traffic: Demonstrates non-uniform linear motion because its speed keeps changing (stopping, accelerating, slowing down) over time due to signals and traffic.

NCERT CLASS 7 SCIENCE

CHAPTER 8 : MEASUREMENT OF TIME AND MOTION

LET US ENHANCE OUR LEARNING – EXERCISE SOLUTIONS

7 Data for an object covering distances in different intervals of time are given in the table. If the object is in uniform motion, fill in the gaps.

Ans.

Time (s)	0	10	20	30	40	50	60	70
Distance (m)	0	8	16	24	32	40	48	56

Explanation : Speed = $\frac{\text{Distance}}{\text{Time}}$

From the table : Speed = $\frac{8\ m}{10\ s}$ = 0.8 m/s

So, distance increases by 8 m every 10 s.

Hence, the gaps are filled as above.

8 A car covers 60 km in the first hour, 70 km in the second hour, and 50 km in the third hour. Is the motion uniform? Justify your answer. Find the average speed of the car.

Ans.

Nature of motion : Non-uniform.

Because the car covers unequal distances (60 km, 70 km, 50 km) in equal time intervals (1 hour each).

Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

= $\frac{60 + 70 + 50}{1 + 1 + 1}$ $\frac{\text{km}}{\text{h}}$

= $\frac{180\ \text{km}}{3\ \text{h}}$ = **60 km/h**

9 Which type of motion is more common in daily life – uniform or non-uniform? Provide three examples from your experience to support your answer.

Ans.

Non-uniform motion is far more common in daily life because moving bodies rarely maintain a constant speed for long durations.

Examples :

1. A person running in a park or marathon.
2. A city bus moving between crowded stops and traffic signals.
3. A train accelerating out of a station and slowing down near another.

10 Data for the motion of an object are given in the table. State whether the speed of the object is uniform or non-uniform. Find the average speed.

Ans.

Time (s)	0	10	20	30	40	50	60	70	80	90	100
Distance (m)	0	6	10	16	21	28	36	43	49	55	60

- Distance covered in each 10 s interval:
  0–10 : 6 m, 10–20 : 4 m, 20–30 : 6 m, 30–40 : 5 m, 40–50 : 7 m, 50–60 : 8 m, 60–70 : 7 m, 70–80 : 6 m, 80–90 : 6 m, 90–100 : 5 m.
  These are not equal.
- Hence, the speed of the object is non-uniform.

Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

= $\frac{60\ m}{100\ s}$ = **0.6 m/s**

11 A vehicle moves along a straight line and covers a total distance of 2 km. In the first 500 m, it moves at 10 m/s and in the next 500 m at 5 m/s. With what speed should it move the remaining distance so that the total journey takes 200 s? What is the average speed for the entire journey?

Ans. Total distance = 2 km = 2000 m

Total time = 200 s

Part 1 : d_1 = 500 m, v_1 = 10 m/s

Time $t_1 = \frac{d_1}{v_1} = \frac{500}{10}$ = 50 s

Part 2 : d_2 = 500 m, v_2 = 5 m/s

Time $t_2 = \frac{d_2}{v_2} = \frac{500}{5}$ = 100 s

Remaining distance :

d_3 = 2000 – (500 + 500) = 1000 m

Remaining time :

t_3 = 200 – (50 + 100) = 50 s

Required speed for remaining distance :

$v_3 = \frac{d_3}{t_3} = \frac{1000}{50}$ = **20 m/s**

Average speed for entire journey :

Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

= $\frac{2000}{200}$ = **10 m/s**

KEY FORMULAS TO REMEMBER :

1. Speed = Distance / Time
2. Average Speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

NCERT CLASS 7 SCIENCE

CHAPTER 8 : MEASUREMENT OF TIME AND MOTION

LET US ENHANCE OUR LEARNING – EXERCISE SOLUTIONS

12 A car covers a distance of 105 km in the first hour, 95 km in the second hour and 110 km in the third hour. Is the motion uniform? Find the average speed of the car.

Ans.

- The motion is non-uniform because the car covers unequal distances in equal intervals of time (105 km, 95 km, 110 km in 1 hour each).

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$= \frac{105 + 95 + 110}{1 + 1 + 1} \ \frac{\text{km}}{\text{h}}$$

$$= \frac{310 \text{ km}}{3 \text{ h}} = \boxed{103.33 \text{ km/h}}$$

13 A cyclist covers a distance of 30 km in 2 hours. For the next 30 km, he takes 3 hours. Find his average speed for the entire journey.

Ans.

Total distance = 30 + 30 = 60 km

Total time = 2 + 3 = 5 hours

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$= \frac{60 \text{ km}}{5 \text{ h}} = \boxed{12 \text{ km/h}}$$

14 An athlete runs 1 km in 4 minutes and another 1 km in 6 minutes. Find his average speed for the entire distance.

Ans.

Total distance = 1 km + 1 km = 2 km

Total time = 4 min + 6 min = 10 min

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$= \frac{2 \text{ km}}{10 \text{ min}} = \boxed{0.2 \text{ km/min}}$$

$$\text{(or)} = \frac{200 \text{ m}}{60 \text{ s}} = \boxed{3.33 \text{ m/s}}$$

15 A train starts from rest and accelerates uniformly to a speed of 72 km/h in 5 minutes. Find the acceleration of the train in m/s^2.

Ans.

Initial speed, $u = 0$ (starts from rest)

Final speed, $v = 72 \text{ km/h} = 72 \times \frac{5}{18} \text{ m/s}$

$= 20 \text{ m/s}$

Time, $t = 5 \text{ min} = 5 \times 60 = 300 \text{ s}$

$$\text{Acceleration, } a = \frac{v - u}{t}$$

$$= \frac{20 - 0}{300} = \boxed{\frac{1}{15} \text{ m/s}^2}$$

$$= 0.0667 \text{ m/s}^2$$

16 A car travels at a speed of 60 km/h for 2 hours and then at a speed of 40 km/h for the next 3 hours. Find the average speed for the entire journey.

Ans.

Distance in 2 hours at 60 km/h = 60 × 2 = 120 km

Distance in 3 hours at 40 km/h = 40 × 3 = 120 km

Total distance = 120 + 120 = 240 km

Total time = 2 + 3 = 5 hours

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$= \frac{240 \text{ km}}{5 \text{ h}} = \boxed{48 \text{ km/h}}$$

17 A person walks the first 2 km at a speed of 4 km/h, the next 2 km at 6 km/h and the next 2 km at 3 km/h. Find the average speed for the entire journey.

Ans.

Part 1 : $d_1 = 2 \text{ km}, v_1 = 4 \text{ km/h} \Rightarrow t_1 = \frac{d_1}{v_1} = \frac{2}{4} = 0.5 \text{ h}$

Part 2 : $d_2 = 2 \text{ km}, v_2 = 6 \text{ km/h} \Rightarrow t_2 = \frac{2}{6} = \frac{1}{3} \text{ h}$

Part 3 : $d_3 = 2 \text{ km}, v_3 = 3 \text{ km/h} \Rightarrow t_3 = \frac{2}{3} \text{ h}$

Total distance = 2 + 2 + 2 = 6 km

Total time = $0.5 + \frac{1}{3} + \frac{2}{3} = 0.5 + 1 = 1.5 \text{ h}$

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$= \frac{6 \text{ km}}{1.5 \text{ h}} = \boxed{4 \text{ km/h}}$$

18 State whether the following statements are True or False.

(i) A body travels a larger distance in a given time interval when it is moving faster. Ans. True

(ii) Speed is same as velocity. Ans. False

(iii) An object moving with uniform speed in a straight line has uniform velocity. Ans. True

(iv) If an object is moving in a circular path with uniform speed, its velocity is uniform. Ans. False

(v) Average speed of an object can never be equal to its instantaneous speed. Ans. False

IMPORTANT POINTS TO REMEMBER :

- ★ Speed = Distance / Time ★ Average Speed = Total Distance / Total Time
- ★ Uniform Motion → Equal distances in equal intervals of time.
- ★ Non-uniform Motion → Unequal distances in equal intervals of time.
- ★ Units of speed : m/s (SI unit), km/h (commonly used)

QUICK REVISION NOTES & KEY DEFINITIONS

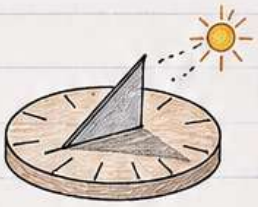
Chapter 8 : Measurement of Time and Motion

Topic-wise Textbook Summary & Formulas

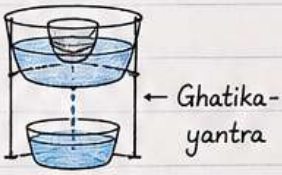
1. MEASUREMENT OF TIME & ANCIENT DEVICES

- **Natural Timekeeping** : Ancient people tracked time using periodic events in nature (rising/setting Sun for days, Moon phases for months, seasons for years).
- **Early Time-Measuring Instruments** :

→ **Sundials** : Measure time using the changing length and position of shadows cast by sunlight.



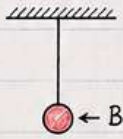
→ **Water Clocks** : Rely on water flowing out of a marked vessel or a sinking floating bowl (Ghatika-yantra).



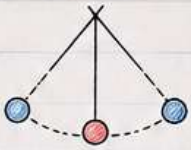
→ **Hourglasses** : Measure time by sand trickling from one glass bulb to another.

→ **Candle Clocks** : Candles marked at regular intervals that indicate time as they burn down.

2. KEY DEFINITIONS



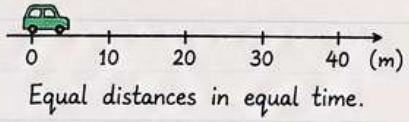
- **Simple Pendulum** : A setup consisting of a small metallic ball (called a bob) suspended from a rigid support by a long thread.
- **Mean Position** : The position of rest of a pendulum bob when it is hanging freely without oscillating.



- **Oscillatory / Periodic Motion** : A to-and-fro motion that repeats itself after regular intervals of time.
- **Time Period** : The time taken by a pendulum or oscillating system to complete one full oscillation.
- **Speed** : The distance covered by an object in a unit time.

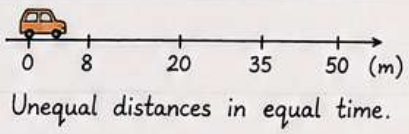
$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}}$$ (Units : m/s, km/h)

- **Uniform Linear Motion** : Motion of an object along a straight line with a constant speed, covering equal distances in equal intervals of time.



Equal distances in equal time.

- **Non-Uniform Linear Motion** : Motion of an object along a straight line where its speed keeps changing, covering unequal distances in equal intervals of time.



Unequal distances in equal time.

QUICK REVISION NOTES & KEY DEFINITIONS

Chapter 8 : Measurement of Time and Motion

Topic-wise Textbook Summary & Formulas

3. MOTION – IMPORTANT POINTS

- Motion is a change in position of an object with time
- It is described in terms of distance, time and speed.
- Speed tells us how fast an object is moving.
- The path of motion in a straight line is called linear motion.
- Motion can be uniform or non-uniform.

4. TYPES OF MOTION

1. **Uniform Linear Motion** : Object covers equal distances in equal intervals of time.

   Example : A car moving on a straight highway with no traffic.

2. **Non-Uniform Linear Motion** : Object covers unequal distances in equal intervals of time.

   Example : A car moving in city traffic.

5. IMPORTANT FORMULAS

Quantity	Formula	Meaning	Units
Speed (v)	$v = \frac{\text{Distance covered}}{\text{Time taken}}$	Speed is equal to distance covered per unit time.	m/s or km/h
Average Speed (v_{avg})	$v_{avg} = \frac{\text{Total Distance}}{\text{Total Time}}$	Average speed is total distance divided by total time.	m/s or km/h
Time (t)	$t = \frac{\text{Distance}}{\text{Speed}}$	Time taken is distance divided by speed.	s or h
Distance (d)	$d = \text{Speed} \times \text{Time}$	Distance is speed multiplied by time.	m or km

Conversion of Units	
	$1\ \text{km/h} = \frac{5}{18}\ \text{m/s}$
	$1\ \text{m/s} = \frac{18}{5}\ \text{km/h}$

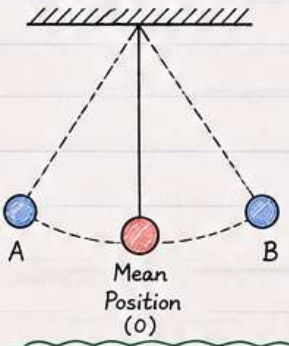
★ 1 hour = 60 minutes = 3600 seconds

1 km = 1000 m

6. SUMMARY TABLE

Concept	Key Point	Example
Measurement of Time	Done using natural events and early instruments before clocks.	Sundial, Water clock, Hourglass, Candle clock
Time Period	Time taken to complete one full oscillation.	Simple pendulum
Uniform Motion	Equal distances in equal intervals of time.	Train moving at constant speed
Non-Uniform Motion	Unequal distances in equal intervals of time.	Bus in city traffic
Speed	Distance covered in a unit time.	Runner, Cyclist, Car
Average Speed	Total distance divided by total time.	Long journey in parts

7. SIMPLE PENDULUM – KEY POINTS



★ Mean position (O) is the position of rest.

★ A simple pendulum shows oscillatory (periodic) motion.

★ Time period (T) is the time taken to go A → B → A (One full oscillation).

Key Terms of Pendulum

Bob : Small metallic ball at the end.
Thread : Light, inextensible string.
Mean Position : Position of rest of the bob.
Oscillation : One complete to and fro motion (A → B → A).
Time Period (T) : Time taken for one oscillation.

KEY TAKEAWAY → Time tells us "when". Motion tells us "how". Speed tells us "how fast".

QUICK REVISION NOTES & KEY DEFINITIONS

Chapter 8 : Measurement of Time and Motion

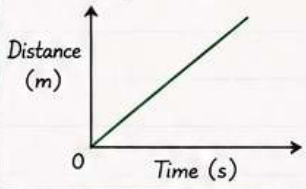
Topic-wise Textbook Summary & Formulas

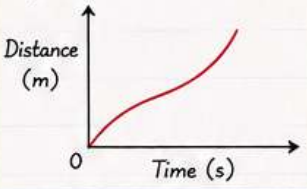
14. EXAMPLES OF UNIFORM & NON-UNIFORM MOTION

Uniform Motion	Non-Uniform Motion
• A car moving on a straight highway with no traffic. • A train moving at a constant speed on a straight track. • A conveyor belt of a factory moving at constant speed.	• A car in city traffic. • A bus that stops at every bus stop. • A train accelerating after the station and slowing down before the next station.

15. DISTANCE-TIME GRAPH

Uniform Motion	Non-Uniform Motion
Straight line graph. Distance increases by equal amounts in equal intervals of time.	Curved line graph. Distance increases by unequal amounts in equal intervals of time.





16. PROBLEMS – KEY APPROACH

- Read the question carefully and note the given data.
- Write the formula that represents the situation.
- Use correct units and convert if required.
- Substitute the values and calculate.
- Write the answer with proper units.

Remember the Steps

Understand the question
↓
Write the formula
↓
Substitute the values
↓
Calculate
↓
Write the answer with units

17. IMPORTANT UNITS

Quantity	SI Unit	Symbol	Other Common Units
Time	second	s	minute (min), hour (h)
Length / Distance	metre	m	kilometre (km)
Speed	metre per second	m/s	kilometre per hour (km/h)

18. SPEED UNITS CONVERSION

$1 \text{ km/h} = \frac{5}{18} \text{ m/s}$

$1 \text{ m/s} = \frac{18}{5} \text{ km/h}$

Shortcut

To convert m/s to km/h multiply by $\frac{18}{5}$

To convert km/h to m/s multiply by $\frac{5}{18}$

19. TIPS TO SOLVE NUMERICALS

- Check the given data and convert units first if needed.
- Identify what is asked – speed, time or distance.
- Use the correct formula.
- Show all steps neatly.
- Don't forget to write the unit in the final answer.

20. REAL LIFE APPLICATIONS

- Speed helps in designing vehicles and transport systems.
- Time measurement is important in daily activities, sports, industries and technology.
- Clocks and watches are used everywhere – in schools, homes, offices, railways, airports, etc.

21. SUMMARY – AT A GLANCE

Concept	Key Idea	Formula / Rule	Example
Measurement of Time	Time measured using natural events and ancient instruments.	Sundial, Water clock, Hourglass, Candle clock	Sundial uses shadow of Sun to tell time.
Speed	Distance covered in unit time.	Speed (v) = $\frac{\text{Distance}}{\text{Time}}$	Car covers 100 km in 2 h, speed = 50 km/h
Uniform Motion	Equal distances in equal intervals of time.	Speed is constant.	Train moving at constant speed.
Non-Uniform Motion	Unequal distances in equal intervals of time.	Speed keeps changing.	Car in city traffic.
Average Speed	Total distance divided by total time.	Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$	Car covers 300 km in 5 h, average speed = 60 km/h
Time Period	Time taken for one full oscillation.	—	A pendulum takes 2 s to complete one oscillation.

KEY TAKEAWAY

Time is measured using natural events and instruments.
Motion is described using speed, distance and time.
Use formulas with correct units to get accurate answers.

QUICK REVISION NOTES & KEY DEFINITIONS

Chapter 8 : Measurement of Time and Motion

Topic-wise Textbook Summary & Formulas

8. FACTS TO REMEMBER

- Speed has both magnitude and direction.
- Speed of an object may change by changing its direction even if its magnitude remains the same.
- The SI unit of speed is metre per second (m/s).
- We commonly use kilometre per hour (km/h).
- 1 m/s = 3.6 km/h
- 1 km/h = $\frac{5}{18}$ m/s

9. COMMON CONVERSIONS

From	To
m/s	km/h : Multiply by $\frac{18}{5}$
km/h	m/s : Multiply by $\frac{5}{18}$

Example :
20 m/s
= 20 × $\frac{18}{5}$
= 72 km/h

Example :
54 km/h
= 54 × $\frac{5}{18}$
= 15 m/s

10. EQUATIONS OF MOTION (FOR UNIFORM LINEAR MOTION)

1. Speed Formula

$$\text{Speed } (v) = \frac{\text{Distance } (d)}{\text{Time } (t)}$$

Units : m/s or km/h

2. Time Formula

$$\text{Time } (t) = \frac{\text{Distance } (d)}{\text{Speed } (v)}$$

Units : s or h

3. Distance Formula

$$\text{Distance } (d) = \text{Speed } (v) \times \text{Time } (t)$$

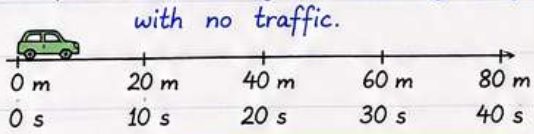
Units : m or km

11. UNIFORM VS NON-UNIFORM MOTION

Uniform Linear Motion

- Object moves with constant speed in a straight line.
- Covers equal distances in equal intervals of time.

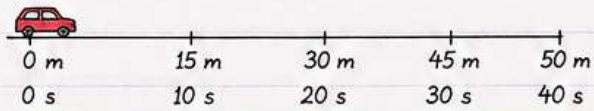
Example : Car moving on a straight highway with no traffic.



Non-Uniform Linear Motion

- Object moves with changing speed in a straight line.
- Covers unequal distances in equal intervals of time.

Example : Car moving in city traffic.



12. AVERAGE SPEED

- When speed is not constant, we use average speed.
- Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

Units : m/s or km/h

Example : A car covers 300 km in 5 hours.
Average speed = $\frac{300 \text{ km}}{5 \text{ h}}$ = 60 km/h

13. TYPES OF TIME

- Hour (h), Minute (min), Second (s)
- 1 hour = 60 minutes
- 1 minute = 60 seconds
- 1 hour = 60 × 60 = 3600 seconds

Quick Conversions

- 1 hour = 60 minutes = 3600 seconds
- 30 minutes = 1800 seconds
- 1 km = 1000 m

KEY TAKEAWAY - Time is measured using natural events and instruments. Motion is described using speed, distance and time. Uniform motion has constant speed, non-uniform motion has changing speed. Use correct formulas and units to solve problems.