

Measurement of Time and Motion

Chapter Notes:

Measurement of Time

- Timekeeping began with observation of natural events (sunrise, sunset, moon phases).
- Ancient time devices: Sundials, water clocks, hourglasses, candle clocks.
- Pendulum clock: Invented by Christiaan Huygens in 1656; based on Galileo's observations.
- Simple pendulum: A bob tied to a thread. One oscillation = mean → one extreme → other extreme → mean.
- Time period: Time to complete one oscillation. Depends on the length, not mass.
- SI Unit of Time: Second (s). Other units: minute (min), hour (h).
- Modern clocks: Use quartz crystals or atomic vibrations for high precision.

Slow or Fast

- Faster objects cover more distance in the same time.
- Speed helps compare fast/slow motion.

Speed

- Speed = Distance / Time
- SI unit: m/s; other: km/h.^L
- Average speed is used when speed is not constant.

Uniform and Non-uniform Linear Motion

- Uniform motion: Equal distances in equal time.
- Non-uniform motion: Unequal distances in equal time.
- Real-life motions are usually non-uniform.



Fill in the blanks

- 1. The SI unit of time is ______.
- 2. A simple pendulum completes one _____ in a fixed time.
- 3. _____ is the distance covered in unit time.
- 4. _____ means equal distance in equal time.
- 5. A ______ is used for precise measurement of time.

Multiple Choice Questions (MCQs)

- 1. Which of the following is NOT an ancient time measuring device?
- A. SundialB. Water clockC. SmartwatchD. Hourglass
- 2. One oscillation of a pendulum is when the bob moves:
- A. From one side to mean position B. From mean to one extreme C. From one extreme to other and back D. None of these
- 3. The SI unit of speed is:
- A. km/h
- C.s

- B. m/s D. m/min
- 4. In uniform motion, an object:
- A. Moves with increasing speed
- C. Moves with varying speed
- B. Covers unequal distances
- D. Covers equal distances in equal time
- 5. The time period of a pendulum depends on:
- A. Mass of bob
- C. Length of string

- B. Shape of bob
- D. Material of bob

True or False

- 1. The time period of a pendulum depends on its mass.
- 2. SI unit of time is minute.
- 3. Sundial uses shadow to measure time.
- 4. Non-uniform motion means equal distance in equal time.
- 5. Pendulum clock was invented by Huygens.



Short Answer Questions

1. What is a stopwatch and where is it used?	
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Ans: _____

Q3. Why are atomic clocks considered very accurate?
Ans: _____

Q4. What is meant by average speed?
Ans:
Q5. Why do we need accurate measurement of time in sports?
Ans:
Q6. How is time measured in modern devices?
Q7. Which type of clock was used in Buddhist monasteries in ancient India?
Ans:
Q8. Why is a swing considered an example of a pendulum?
Ans:
Q9. Why should we not push the pendulum while releasing it in experiments?

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Ans: _____

Numericals Problems

1. A car covers 240 km in 4 hours. What is its speed? Solution:

2. A runner completes 100 metres in 12.5 seconds. What is the speed in m/s? Solution:

3. A train travels at a speed of 72 km/h. How much distance will it cover in 3 hours? Solution:

4. Convert 36 km/h to m/s. Solution:

5. A cyclist covers 15 km in 50 minutes. Find the speed in m/s. Solution:

6. A vehicle moves at 90 km/h. How much time will it take to travel 180 km? Solution:

7. A pendulum completes 20 oscillations in 32 seconds. Find its time period. Solution:

8. A train travels 360 km in 5 hours. Find its speed in m/s. Solution:

9. A sprinter runs at 8 m/s. How much distance will she cover in 25 seconds? Solution:

10. A man walks at a speed of 5 km/h. How far will he walk in 45 minutes? Solution:

11. A bus takes 3 hours to travel 210 km. What is its average speed? Solution:

12. A car moves at 60 km/h for 30 minutes. What distance does it cover? Solution:

13. A train covers 500 m in 25 seconds. Find its speed in m/s and km/h. Solution:

14. A person jogs 1200 m in 8 minutes. Find speed in m/s. Solution:

15. A pendulum takes 15 seconds to complete 10 oscillations. Find time period.

16. A train travels 120 km at 60 km/h and then 180 km at 90 km/h. What is its average speed for the entire journey? Solution:



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Solution:

17. A cyclist travels 20 km in the first hour, 30 km in the second hour, and 50 km in the third hour. What is the average speed?

Solution:

18. A car covers the first 2 km at 20 m/s and the next 3 km at 30 m/s. Find the average speed of the car in m/s.

Solution:

19. A pendulum makes 80 oscillations in 2 minutes. What is its time period? Solution:

20. A train starts from rest and reaches a speed of 60 km/h in 2 minutes. If it accelerates uniformly, find the average speed and the distance covered. Solution:



Answers

Fill in the Blanks

1. second	2. oscillation	3. Speed		4. Uniform motion	5. stop	watch		
Multiple Choice Questions (MCQs)								
1. C. Smartwatch 2		2. C. Fror	2. C. From one extreme to other and back			3. B. m/s		
4. D. Covers equal distances in equal time 5. C. Length of string								
True or False								
1. → False		2.	\rightarrow	False		3. → True		
4. → False		5.	. → 1	True		6. → True		

Short Answer Questions

Ans 1: A stopwatch is a device used to measure short time intervals precisely. It is commonly used in sports events to time races and athletic performances.

Ans 2: A pendulum provides a consistent time interval through its oscillations, which helps in accurate timekeeping in pendulum clocks.

Ans 3: Atomic clocks measure time based on the vibrations of atoms, which are extremely consistent, allowing them to lose only one second in millions of years.

Ans 4: Average speed is the total distance covered divided by the total time taken, especially when the speed varies during motion.

Ans 5: Because in sports, results can depend on differences of a fraction of a second, accurate timing helps determine winners fairly.

Ans 6: Modern clocks measure time using periodic vibrations of quartz crystals or atoms in atomic clocks.

Ans 7: Ghatika-yantra (sinking bowl water clock).

Ans 8: Because it shows oscillatory motion, similar to a pendulum's to-and-fro movement.

Ans 9: To ensure that it swings naturally and provides accurate time period measurements.

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Numericals Problems

- 1. Speed = Distance / Time = 240 km / 4 h = 60 km/h
- 2. Speed = 100 m / 12.5 s = 8 m/s
- 3.Distance = Speed × Time = 72 × 3 = 216 km
- 4. 1 km/h = 5/18 m/s, So, 36 × 5/18 = 10 m/s
- 5. Convert distance: 15 km = 15,000 m, Time = 50 × 60 = 3000 s, Speed = 15000 / 3000 = 5 m/s
- 6. Time = Distance / Speed = 180 / 90 = 2 hours
- 7. Time period = Total time / No. of oscillations = 32 / 20 = 1.6 s
- 8. Speed = 360 / 5 = 72 km/h, Convert: 72 × 5/18 = 20 m/s
- 9. Distance = Speed × Time = 8 × 25 = 200 m
- 10. Time = 45 min = 0.75 h, Distance = 5 × 0.75 = 3.75 km
- 11. Speed = 210 / 3 = 70 km/h
- 12. Time = 30 min = 0.5 h, Distance = 60 × 0.5 = 30 km
- 13. Speed = 500 / 25 = 20 m/s, Convert: 20 × 18/5 = 72 km/h

14. Time = 8 × 60 = 480 s, Speed = 1200 / 480 = 2.5 m/s

15. Time period = 15 / 10 = 1.5 s

16.

Time for 1st part = 120 / 60 = 2 hTime for 2nd part = 180 / 90 = 2 hTotal distance = 120 + 180 = 300 kmTotal time = 2 + 2 = 4 hAverage speed = 300 / 4 = 75 km/h

17.

Total distance = 20 + 30 + 50 = 100 km Total time = 3 h Average speed = 100 / 3 = 33.33 km/h

18.

Time₁ = 2000 / 20 = 100 s Time₂ = 3000 / 30 = 100 s Total distance = 2000 + 3000 = 5000 m Total time = 200 s Average speed = 5000 / 200 = 25 m/s

19.

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Time period = 120 / 80 = 1.5 s

Total time = 2 min = 120 s

20.

Initial speed (u) = 0, Final speed (v) = 60 km/h = 16.67 m/s Time = 2 min = 120 s Average speed = (0 + 16.67) / 2 = 8.335 m/s Distance = avg. speed × time = $8.335 \times 120 \approx 1000.2$ m

