MATRIX OLYMPIAD

The Most Innovative Talent Recognition Exam

PHYSICS

Class - VII

MATRIX

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Few words for the Readers

Dear Reader,

"*Matrix Olympiad is established to encourage school students to go a step further than their regular studies, and get a chance and exposure to competition on a wide scale. It also helps students enhance their learning of basic cognitive skills and deeper knowledge of subjects like Science, Mathematics, English, Mental Ability, Social Studies.“Matrix Olympiad helps students nurture their minds for higher targets of tomorrow and enables them to study School for JEE, NEET, CLAT, NDA, Olympiads , NSEJS, NTSE , STSE etc.*"

The above thought has been our guiding principle while designing and collating the study material for **Matrix Olympiad** . And hence, we hope that this particular material will be helpful towards your preparation for **Matrix Olympiad**.

Our team at **MATRIX** has put in their best efforts for making this particular module interesting and relevant for you. Additional efforts have been made to ensure that the content is easy to understand and error free to the extent possible. However, there might remain some inadvertent errors in answer keys and theoretical portion and we would welcome your valuable feedback regarding the same.
If there are any suggestions for corrections, please write to us at **smd@matrixacademy.co.in** and we would be highly grateful.

Finally, we would like to end this message by a famous quote by Ernest Hemingway - "*There is no friend as loyal as a book*." So, please give your study material the time and attention it deserves, and it will surely help you reach newer heights in your fight with competition examinations.

With love and best wishes !
Team MATRIX

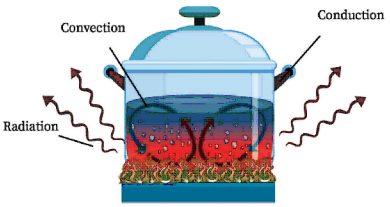
CONTENTS

HEAT 1

Concepts

Introduction

1. *Heat and temperature*
2. *Sources of heat energy*
3. *Effects of heat energy*
4. *Hot and cold*
5. *Difference between heat and temperature*
6. *Measuring Temperature*
   - *6.1 Types of thermometer*
     - ☛ *Clinical thermometer*
     - ☛ *Laboratory thermometer*
     - ☛ *Precaution to be observed while reading a Clinical thermometer*
7. *Transfer of heat*
   - *7.1 How does heat flow ?*
     - ☛ *Conduction*
     - ☛ *Conductors and insulators*
     - ☛ *Convection*
     - ☛ *Applications of convection*
     - ☛ *Radiation*



Solved Examples

Exercise – I (SCQ Type)

Exercise – II (Board Pattern Type)

Answer Key

INTRODUCTION

We observe that when a pressure cooker is heated on a gas stove, the water in the pressure cooker gets heated and after some time the steam comes out through the nozzle by lifting the weight over the nozzle. This shows that work is done on the weight. We know that capacity to do work is called energy. In this case the work is done due to the heat supplied to the pressure cooker. Thus, we can conclude that heat is a form of energy.

In the ancient times, people used to produce fire by rubbing stones against one another. In an electric iron box, we get heat from electricity. When a candle is lit, the chemical energy stored in the candle generates heat. Thus, heat energy is produced at the expense of some other forms of energy. A steam engine works by converting heat energy into mechanical energy. When a tungsten filament gets intensely hot, it produces light. Thus, heat energy can be transformed to some other forms of energy. So, it is needless to say that heat is a form of energy.

Heat energy can be transformed into other forms of energy like electrical, mechanical, light etc., by suitable methods. Heat energy can bring about changes in the physical dimensions, state and the chemical properties of a substance.

1. HEAT AND TEMPERATURE

Heat is an invisible form of energy that can produce the sensation of hot or cold. The property that tells us how hot or cold a particular body is called its **Temperature**, i.e., the degree of hotness or coldness of a body is denoted by its **Temperature**. When heat is supplied to a body, its temperature increases and when heat is taken away from a body, its temperature decreases.

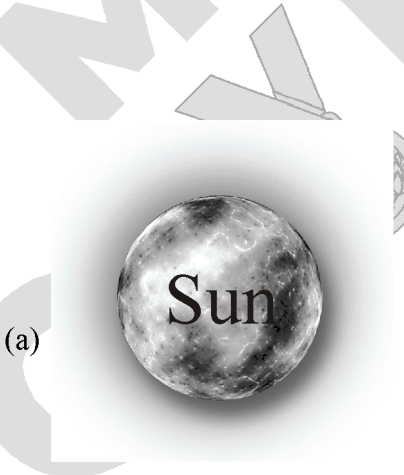


Figure : Natural source of heat

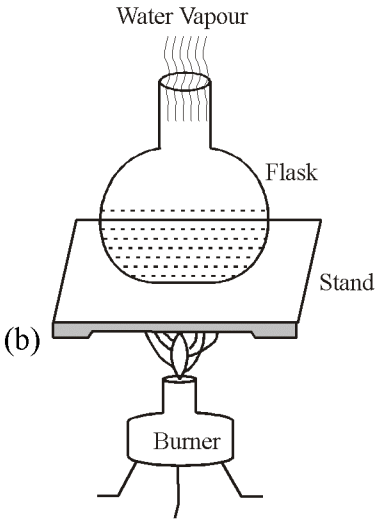


Figure : Artificial source of heat

2. SOURCES OF HEAT ENERGY

Sun is the Earth's main source of heat energy. Other sources of heat include burning of fuels eg. wood, coal, kerosene and liquefied petroleum gas (LPG), rubbing of two surfaces against each other or from electricity. Heat always flows from a body of higher temperature to the body at lower temperature

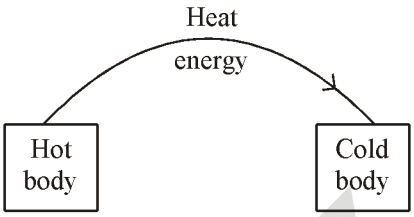


Figure :

A body which is losing heat is feeling the other body to be cold, and a body which is gaining heat is feeling the other body to be hot.

Unit of Heat Energy

S.I. unit of heat in joule (J). Another commonly used unit of heat is calorie (cal).

1 calorie = 4.18 J = 4.2 J

1 kilocalorie (kcal) = 1000 calories = 4180 J

1 kilojoule (kJ) = 1000 J

1 megajoule (MJ) = 10^6 J

Focus Point

Important things to related to Heat :

- Heat is a scalar quantity
- As heat is a form of energy. So, its unit is same as energy.
- **One calorie is the quantity of heat energy required to raise the temperature of 1 g of water through 1°C.**
- If heat can flow between two objects or systems, the objects or systems are said to be in **thermal contact**.

3. EFFECTS OF HEAT ENERGY

(a) Heat energy brings about change in temperature conversely, if a hot body gives out heat energy, its temperature falls.

(b) Heat energy brings about change in dimensions when a material body is heated. Its length, area and volume increases.

(c) Heat energy brings about change in state. When heat supplied to the solid, at a particular constant temperature it changes into the liquid state. Similarly liquid changes into gaseous state. During the change of state, the temperature of the body remains constant.

(d) Heat energy affects the living things.

(e) Heat energy brings about chemical change when calcium carbonate is heated strongly, it changes into calcium oxide and carbon dioxide.

4. HOT AND COLD

How do we compare the heat energy contained in different bodies. We see that some objects around us are cold while some others are hot. How do we say whether a body is hotter or colder? We often try to know the same by touching them. But is it possible to use the same method always?

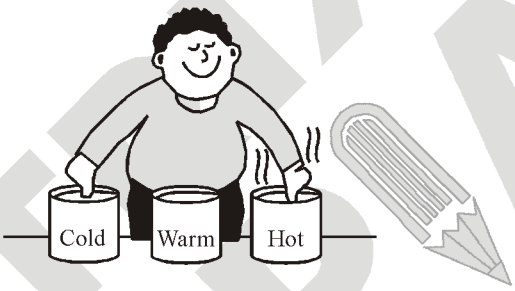


Figure :

Then how do we find out how hot an object really is? A reliable method to determine the hotness of an object is measuring its temperature.

Example 1

When two bodies of different temperatures are in contact, what is the direction of flow of heat?

Solution :

Heat always flows from a body of higher temperature to one of lower temperature.

5. DIFFERENCE BETWEEN HEAT AND TEMPERATURE

	Heat		Temperature
1	Heat is a form of energy	1.	Temperature indicate the thermal condition of a body i.e., how much hot (or) how much cold the body is.
2	Heat is the cause	2	Temperature is the effect
3	Heat is a scalar quantity. It only have magnitude.	3	Temperature of a body decides the direction of heat flow from the body
4	S.I. unit of heat is joule (J)	4	S.I. unit of temperature is kelvin (K).

6. MEASURING TEMPERATURE

Temperature is measured by a device called thermometer. The property of the expansion and contraction of substances due to heating and cooling is made use in **Thermometres**. Generally mercury is used in the thermometer.

6.1 TYPES OF THERMOMETER

Clinical thermometer

It is a thermometer used to measure body temperature. The liquid used in it is mercury. It is used for the temperature range 35°C to 42°C. (or 94°F to 108°F). This is because the body temperature usually does not fall below 35°C or rise above 42°C. The bigger marks normally read 1°C. If there are 5 divisions between bigger marks, each small division reads (1/5) of a degree or 0.2 °C.

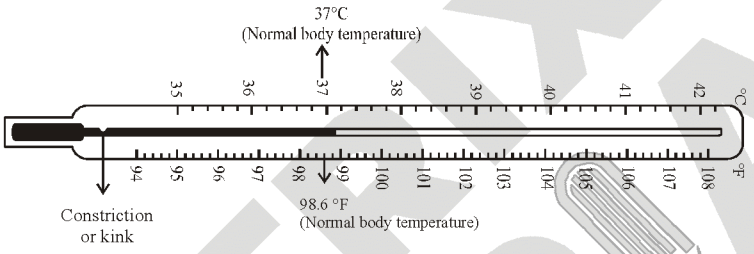


Figure : A clinical thermometer

Focus Point

Temperature is measured in Kelvin (K) in SI system and °C in CGS system.

Conversion of temperature from Kelvin scale to Celsius scale is

$T(K) = T(°C) + 273$

Normal body temperature is 37°C or 98.6°F.

Laboratory thermometer

The thermometers available in the laboratory consist of a long sealed glass tube (also called stem) marked with a scale on the outside (see fig). Inside the glass tube there is an another thin tube called the capillary tube (or bore) at the end of which there is a bulb made of thick glass. The bulb is filled with a liquid at the other end. The most commonly used liquid is **Mercury**. A shining thread of mercury can be seen from outside the thermometer. As the temperature rises, the mercury in the bulb expands and rises into the capillary tube. The scale on the glass tube is marked in °C or °F. The height of the liquid in the stem gives the reading of temperature. Laboratory thermometers have a range from –10°C to 110°C.

While measuring temperature with a laboratory thermometer, the following precautions should be taken :

(i) The thermometer is delicate and should be handled with care to avoid breakage.

(ii) It should be kept upright and not tilted.

(iii) The bulb should be completely surrounded by the substance whose temperature is being measured, and the bulb should not touch the sides of the container.

(iv) While reading the thermometer, the level of mercury should be the same level as the eye.

(v) The thermometer should not be held by the bulb while reading the temperature.

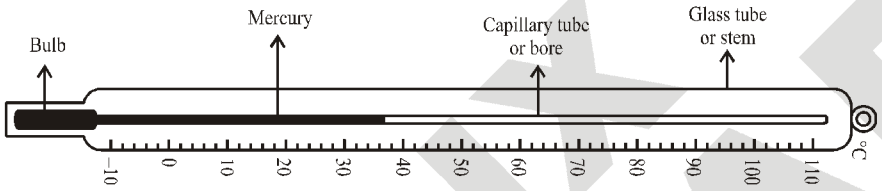


Figure : Laboratory thermometer

Focus Point

THERMOMETRY

Thermometry is the branch of heat dealing with the measurement of temperature. The degree of hotness or coldness of the body is called temperature. S.I. unit of temperature is kelvin (K). Other unit of temperature is degree Celsius (°C) and degree Fahrenheit (°F).

Fahrenheit scale

On the Fahrenheit scale, water freezes at 32 degrees and boils at 212 degrees. There are 180 Fahrenheit degrees between the freezing point and the boiling point of water.

Celsius scale

The Celsius scale divides the interval between the freezing and boiling points of water into 100 degrees (instead of 180). Water freezes at 0°C and boils at 100°C. Most scientists and engineers use Celsius because 0 and 100 are easier to work with, than 32 and 212.

Kelvin scale

This scale is based on the existence of absolute zero, the minimum possible temperature.

Absolute zero

Absolute zero is the lowest temperature in the universe. At absolute zero, there is no heat and the motion of particles (atoms or molecules) ceases (stops), you can think of absolute zero as the temperature where molecules are completely frozen, with no motion. Absolute zero occurs at –273°C or –459°F.

The Kelvin scale divides the interval between the freezing and boiling points of water into 100 divisions. Water freezes at 273 K and boils at 373 K.

A temperature in Celsius measures only relative thermal energy, relative to zero Celsius. The Kelvin temperature scale is useful in science because it starts at absolute zero. A temperature in Kelvin measures the actual energy of atoms relative to zero energy.

Relation between different temperature scales

The relation between the Celsius (C), Fahrenheit (F), and Kelvin (K) scales are :

$$\frac{C-0}{100-0}=\frac{F-32}{212-32}=\frac{K-273}{373-273}=\frac{T-L.F.P.}{U.F.P.-L.F.P.}$$

Where, T is temperature of any scale, L.F.P. is lower fixed point, U.F.P. is upper fixed point.

or $$\frac{C-0}{100}=\frac{F-32}{180}=\frac{K-273}{100}=\frac{T-L.F.P.}{U.F.P.-L.F.P.}$$

Focus Point

Relation between Celsius and Fahrenheit scales

$$\frac{C-0}{100}=\frac{F-32}{180} \text{ or } \frac{C}{100}=\frac{F-32}{180} \text{ or } \frac{C}{10}=\frac{F-32}{18} \text{ or } \frac{C}{5}=\frac{F-32}{9} \text{ or } C=\frac{5}{9}(F-32)$$

$$\text{or } F=\frac{9}{5}C+32 = 1.8C+32$$

$$F = 18\,(K-273)+32$$

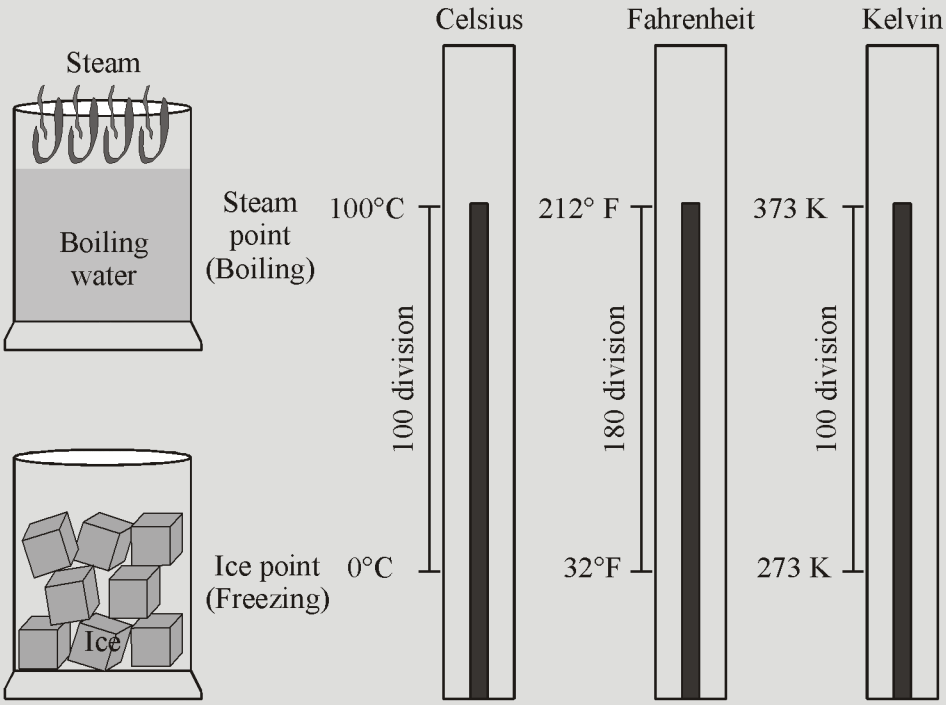
Relation between Celsius and Kelvin scales

$$\frac{C-0}{100}=\frac{K-273}{100}$$

$$\text{or } \frac{C-0}{100}=\frac{K-273}{100}$$

$$\text{or } C = K-273$$

$$\text{or } K = C+273$$



Example 2

At what temperature, if any, do the following pairs of scales give the same reading :

(a) Celsium and Fahrenheit, (b) Fahrenheit and Kelvin and (c) Kelvin and Celsius ?

Solution:

If the temperature is θ at which the reading of two scales coincides, then from :

$$\frac{T_C - 0}{100} = \frac{T_F - 32}{180} = \frac{T_K - 273.15}{100}$$

(a) $\frac{\theta}{100} = \frac{\theta - 32}{180}$, i.e., $\theta = -40$

i.e., reading of Celsius and Fahrenheit scale coincides at –40°.

(b) $\frac{\theta - 32}{180} = \frac{\theta - 273.15}{100}$, i.e., $\theta = 574.6$

i.e., reading of Fahrenheit and Kelvin scale coincides at 574.6°.

(c) $\frac{\theta - 273}{100} = \frac{\theta}{100}$ which is not possible

So reading of Celsius and Kelvin scale can never respectively.

Example 3

Find the value of 5°C in °F and K scale respectively.

Solution:

Relation between Celsius and Fahrenheit scale

$$\frac{C}{5} = \frac{F - 32}{9}$$

So corresponding value of 5°C in Fahrenheit scale is

$$\frac{5}{5} = \frac{F - 32}{9} \quad \Rightarrow F = 41°F$$

Relation between Celsius and Kelvin scale

T(K) = T(°C) + 273 = 5 + 273 = 278 K

Preacaution to be observed while reading a Clinical thermometer

(i) Thermometer should be washed before and after use, preferably with an antiseptic solution.

(ii) Ensure that before use, the mercury level is below 35°C

(iii) Read the thermometer keeping the level of mercury along the line of sight.

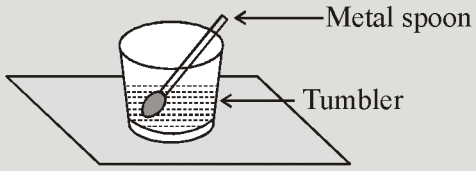
(iv) Handle the thermometer with care. If it hits against some hard object, it can break.

(v) Don't hold the thermometer by the bulb while reading it.

LAB TIME
Let's Do & Learn

Let us perform an activity to understand how heat flows from a body at a higher temperature to one at a lower temperature.

Take some hot water in a tumbler. Dip a metal spoon in this water for some time. How long does it take for the spoon to become hot for you to feel uncomfortable to hold it any more ? This shows that heat is transferred from the hot water in the tumbler to the spoon and then to your hand. Leave the tumbler with water in it for 10-15 minutes. Feel the water now. Has it cooled down ? Why ? Because water has lost its heat to the surroundings. This shows that heat has been transferred from the water to the surroundings.

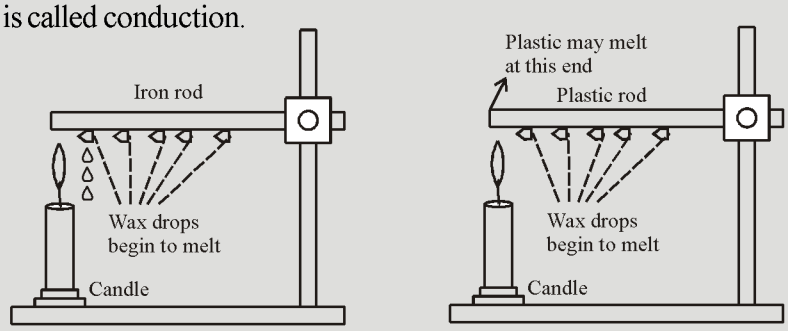


7. TRANSFER OF HEAT

Put a hot object in contact with a cold object. After some time, you would notice that the cold object becomes hot while the hot object becomes less hot. This happens because the hot object transfers some of its heat to the colder object. In fact in all cases heat flows from a hotter object to a colder object.

LAB TIME
Let's Do & Learn

1. Put drops of wax at regular intervals on an iron rod. Heat one end of the rod over a candle flame (see figure). You will observe that the drop nearest to the flame melts first. One by one all the drops melts and the end of the rod opposite to the flame begins to feel ward to the touch.
2. Repeat the same procedure using a plastic rod (see figure). You will observe that the end closer to the flame begins to melt while the wax drops remain unaffected. Also, the rod does not feel warm to the touch.
3. From this activity we can conclude that there are certain materials like metals which allow heat to pass through them while certain materials like plastic do not. Also, the entire rod does not get heated at once. The wax drops melt one by one as the heat reaches each one gradually. This mode of heat transfer is called conduction.



7.1 HOW DOES HEAT FLOW ?

The mechanism by which heat is transferred from one region to another are called modes of heat transfer.

There are three modes of heat transfer :

(i) Conduction (ii) Convection (iii) Radiation.

Conduction

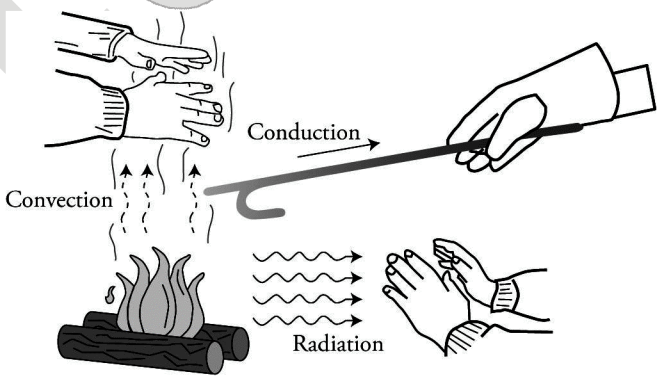
The process of the transfer of heat from the hotter end to the colder end of an object without any movement in the object is called **conduction**. In solids, the heat is transferred by the process of conduction.

Matter is made up of molecules. In solids, molecules are tightly packed. They are not free to move, but they can vibrate about their fixed positions. When one part of a solid is heated, the molecules in that part have more energy and move faster. When mole cubes vibrating more vigorously, they push and pull the molecules of the colder part and make their vibrations more energetic. Thus, energy flows from the hotter to the colder part of the body.

Conductors and insulators

The materials which allow heat to pass through them easily are good conductors of heat. For example, aluminium, iron and copper. The materials which do not allow heat to pass through them easily are poor conductors of heat such as plastic and wood. Poor conductors are known as insulators.Both good and bad conductors are used in cooking utensils. The bottom is made of copper or some other metal. Metals are good conductors, so they conduct heat readily from the fire to the material inside the utensil. The handle, on the other hand, is made of bakelite, which is a bad conductor. Therefore, it does not become too hot even when the utensil is on the fire.

Materials such as wool and cotton are used to make winter clothing, blankets and quilts. This is because they are made of very thin fibres which have a lot of air spaces. Air is a good insulator, so materials with air spaces are good insulators. That is why traditional quilt makers beat cotton to make if fluffy.



Example 4

At what common temperature, would a block of wood and a block of metal feel equally cold or equally hot when touched ?

Solution:

When the temperature of the object equal to that of the human body, no transfer of heat takes place between the body and the object. Thus, when the temperature of the block of wood or block of metal is equal to 37° C, i.e., the temperature of the human body, these appear equally hot or cold on touching on account of non-transference of heat.

LAB TIME
Let's Do & Learn

Let us perform following activity to understand the conductors and insulators.

Take a steel spoon, a geometry box compass, a plastic scale, a pencil and divider. Dip one end of these articles in hot water and wait for a frew minutes. Touch the other end and find out which of the above mentioned articles are conductors and which are insulators. Note down your observation in the following table.

Materials taken	Conductor or Insulator
Steel spoon	
Geometry box compass	
Plastic scale	
Pencil	
Divider	

Convection

The materials which allow heat to pass through them easily are good conductors of heat. In fluids (liquids and gases together), the molecules themselves carry energy from a hotter region to a colder region. This process of heat transfer is called **convection**. Convection plays a major role in weather phenomena, for example, the almost daily rainfall in equatorial regions. In these regions, the almost direct rays of the sun heat the ground rapidly. The air near the ground gets heated and rises. The rising air cools, and the water vapour present in it forms clouds.

Cooler air from above sinks, gets heated and rises again to form more clouds. The clouds bring rain, usually in the afternoon.

Heat transfer in fluids occurs almost exclusively through convection. This is because almost all liquids and gases are poor conductors of heat.

Focus Point

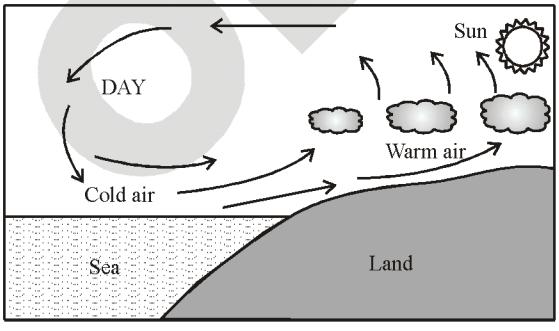
Let us understand that liquids and gases are poor conductor fo heat.

Dip a small nail in molten wax so that it gets a coating of wax. Drop it into a test tube of water. Heat the top of the test tube by holding it above a flame. Heat can now reach the nail from the flame through the water only by conduction and not convection. (Conduction can transfer heat in all directions, while convection can transfer it only upwards.) After some time, the water at the top will begin to boil, but the wax will not melt, showing that water is poor condcutor of heat.

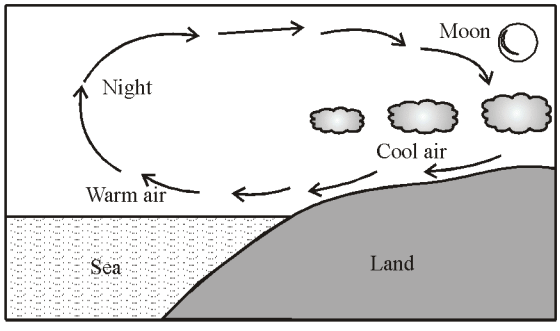
Application of Convection

The following are some applications of convection:

- Ventilators are located near the ceilings of rooms. This allows hot air of the room which has risen up to move out of the ventilator. The fresh cool air from the window rushes in to take the place of rising warm air.
- Air conditions are installed near the roof. The cool air moves down and the warm air near the surface of the room rises up thereby setting up convectional currents which cool the whole room effectively.
- **Land and Sea Breezes :** Convection plays a central role in setting up winds. When some region gets heated, the air over it becomes lighter and moves up. Cold air from neighbouring regions move in to take its place, causing winds. In coastal areas, when the land and the sea absorb heat from the sun during the day, the land heats up faster than the sea. The air above the land becomes hot and moves up, and cooler air from over the sea moves in to take its place. This is called a sea breeze. At night, the air above the land cools faster than the sea.



Sea Breeze



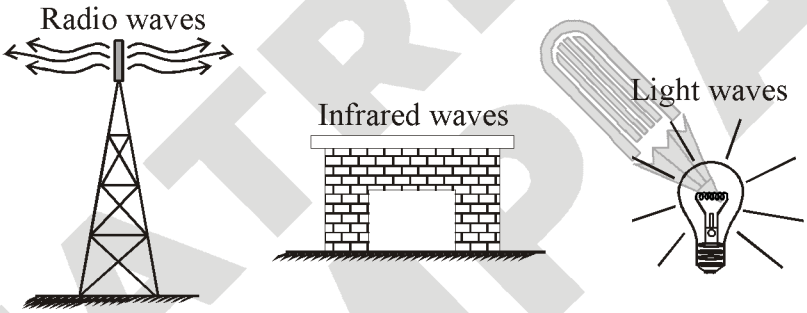
Land Breeze

Radiation

When you sit in front of a fire, you feel warmth of the fire. However, the air between you and the fire is a bad conductor of heat and does not get heated up much. Therefore, heat is not reaching you by conduction. It also cannot reach you by convection since convection currents rise upwards. There is therefore another method by which heat reaches you. This method is called **Radiation**. Radiation is the only process of heat transfer that can occur in the absence of any form of medium. It refers to the transmission of energy as electromagnetic radiation. Radiation is the fastest mode of transfer of heat.

All hot objects—solid, liquid or gas—emit radiant energy. When radiant energy falls on another object, it is partially absorbed and partially reflected. The amount of heat absorbed or radiated depends upon the nature and the colour of the object. Dark colours are good absorbers of radiant heat while light colours are poor absorbers and good radiators of heat.

Heat from the Sun reaches the Earth by the process of radiation. In this case, conduction or convection is not possible because of the vacuum between the Sun and the Earth.



Example 5

Why is it more comfortable to wear white or light-coloured clothes in the summer and dark-coloured clothes in the winter ?

Solution:

Light coloured clothes reflect most of the heat that falls on them and, therefore, we feel more comfortable wearing them in the summer. Dark surfaces absorb more heat and, therefore, we feel comfortable with dark coloured clothes in the winter.

Example 6

How does the heat travel in air ? In which direction does the smoke go ? Try an activity to show it.

Solution:

The air near the heat source gets hot and rises. The air from the sides comes in to take its place. In this way the air gets heated. The following activity confirms this idea :

Light a candle, Keep one hand above, the flame and one hand on the side. Be careful. Keep your hands at a safe distance from the flame so that they do not get burnt. The hand above the flame feels hot. This means that hot air moves in upward direction and towards the top, the air gets heated by convection. On the sides, however, there is no convection and air does not feel as hot as at the top.

SOLVED EXAMPLES

SE. 1

What differences can you find between a clinical thermometer and a laboratory thermometer?

Ans. The clinical thermometer is smaller. It measures only from 35°C to 42°C. There is a small bend or kink in the capillary tube. This prevents the mercury from coming down, when the thermometer is taken out of patient's mouth. Thus the doctor can read the temperature after removing the thermometer.

The laboratory thermometer is larger and measures from –10°C up to 110°C or more. It has no kink in its capillary tube.

SE. 2

(i) Raghav has a temperature of 40°C. What would you suggest him to do?

(ii) Can you say which of these is the temperature inside the Sun?

(a) 30°C (b) 300°C

(c) 3000°C (d) 3,000,000°C

Ans. (i) Raghav has fever and should see a doctor.

(ii) 3,000,000°C

SE. 3

Dhruv got a slab of chocolate from his friend on his birthday. He kept it in his bag. On reaching home, he opened his bag and found a brown sticky liquid leaked out of the wrapper. It had spread over some of his books. What do you think happened?

Ans. The chocolate melted in the heat. It changed from a solid to a thick liquid and leaked out, spreading over Dhruv's books.

SE. 4

Complete these sentences.

The air inside the bottle gets _____ and _____. This _____ the balloon fully. When the bottle is taken out of the _____, the air _____ and Due to this the balloon is no longer fully inflated.

This activity show that solids, liquids and gases expand on heating, and contract on cooling.

Ans. The air inside the bottle gets heated and expands. This inflates the balloon fully. When the bottle is taken out of the hot water, the air cools and contracts. Due to this the balloon is no longer fully inflated.

SE. 5

Arrange these in order of decreasing expansion on heating: steel, milk, air.

Ans. Air, milk, steel

SE. 6

Can convection take place in solids? Why?

Ans. No. The molecules in a solid are only free to vibrate about their fixed positions. For convection to take place, the molecules need to move carrying the heat with them. Hence convection can not take place in solids.

SE. 7

In winters, when the sun suddenly goes behind the clouds we feel cold. Can you say why?

Ans. The clouds cut off the radiant heat from the sun.

SE. 8

Why do fire fighters wear special shiny suits when they enter a burning building?

Ans. The shiny suits reflect heat. This protects them when they enter burning buildings.

SE. 9

If you live on the top floor of a building, you must have noticed that, in summer the roof gets very hot. Suggest a few ways by which people who live on the top floor of a building can protect themselves from the radiant heat of the sun?

Ans. The roof top may be painted white so as to reflect the radiant heat from the sun. If green or white Perspex sheets form a roof above, they prevent the main roof from absorbing the radiant heat of the sun. Watering the roof and maintaining a rooftop garden are other ways.

SE. 10

Convert 25 °C to °F.

Ans. $T(°F) = \left(\frac{9}{5} \times T(°C)\right) + 32$

$T\ (°F) = \left(\frac{9}{5} \times 25\right) + 32$

$= (9 \times 5) + 32$

$= 45 + 32$

$= 77\ °F$

SE. 11

Convert 20 K into °C.

Ans. $T(K) = 273.15 + T(°C)$

$20 = 273.15 + T(°C)$

$T(°C) = 20 - 273.15 = -253.15°C$

Space for Notes :

EXERCISE – I

ONLY ONE CORRECT TYPE

1. A clinical thermometer is calibrated from
(A) 35°C to 42°C (B) 10°C to 100°C
(C) 32°C to 110°C (D) 0°C to 100°C

2. Name the thermometer which ranges from –10°C to 110°C
(A) Clinical thermometer
(B) Digital thermometer
(C) Laboratory thermometer
(D) All of these

3. Which one of the following scale has lower fixed point at 0°C ?
(A) Kelvin scale (B) Fahrenheit scale
(C) Celsius scale (D) All of these

4. The normal body temperature in the clinical thermometer on the Celsius scale represents which one of the following temperature?
(A) 24°C (B) 45°C
(C) 57°C (D) 37°C

5. In which of the following, chemical energy is converted into heat energy?
(A) Heater (B) Refrigerator
(C) Candle (D) Motor

6. A liquid changes into a gas at a constant temperature known as its
(A) absolute zero (B) boiling point
(C) evaporation point (D) dew point

7. In solid substances, heat is transferred by
(A) Conduction (B) Convection
(C) Radiation (D) (A) and (C)

8. The handles of cooking vessels are covered with plastic or wood because
(A) they are beautiful
(B) it is customary
(C) they are good conductors of heat
(D) they are bad conductors of heat

9. In conduction, heat flows from
(A) hotter to hotter region
(B) colder to hotter region
(C) hotter to colder region
(D) colder to colder region

10. During the formation of rain, when water vapours change back to liquid in the form of rain drops,____.
(A) Heat is absorbed
(B) Heat is released
(C) Heat is first absorbed and then released
(D) There is no exchange of heat

11. The measure of degree of hotness or coldness of a body is called
(A) Heat energy (B) Celsius
(C) Kelvin (D) Temperature

12. Process of change of state from gaseous state to liquid state is called
(A) freezing (B) sublimation
(C) boiling (D) condensation

13. When two objects are in thermal contact, the heat is transferred by
(A) conduction (B) convection
(C) radiation (D) none of these

14. Which of the following is a good conductor of heat?
(A) Copper (B) Glass
(C) Water (D) Wood

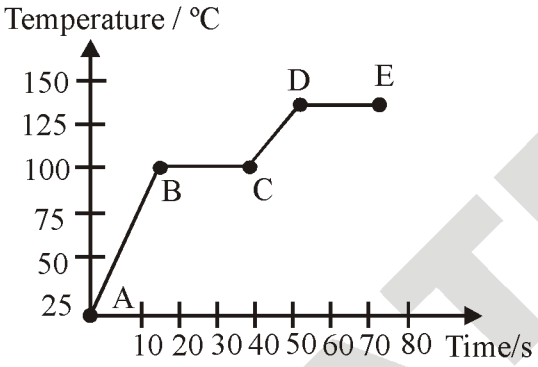
15. The phenomenon involved in sea breeze and land breeze is
(A) convection (B) conduction
(C) radiation (D) none of these

16. Which of the following statements about radiation is/ are true?
1. Radiation can pass through solids.
2. Radiation can pass through liquids.
3. Radiation can pass through gases,

(A) 3 only (B) 2 and 3 only
(C) 1 and 3 only (D) 1, 2 and 3

17. A liquid changes into a gas at a constant temperature known as its
(A) absolute zero
(B) boiling point
(C) evaporation point
(D) dew point

18. Which point on the graph below shows that the substance is beginning to boil?

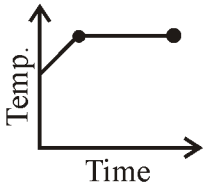


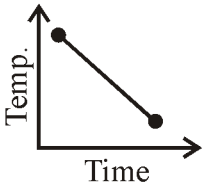
(A) B (B) D
(C) C (D) E

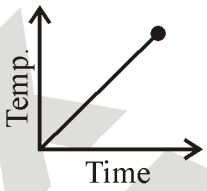
19. When some liquid evaporates, the average speed of the remaining molecules will
(A) increase because the more energetic molecules have left
(B) decrease because the more energetic molecules have left
(C) remain unchanged because all molecules have about the same speed
(D) increase because there are fewer molecules.

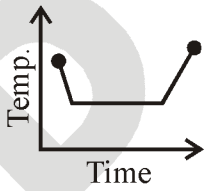
20. Cooling always accompanies evaporation because
(A) the air molecules cool the liquid surface.
(B) the more energetic molecules leave the liquid.
(C) there are fewer liquid molecules left in the liquid.
(D) the escaped molecules return to the liquid.

21. A pot full of water is put to boil on the stove. Which one of the graphs below shows the correct change in temperature over time?

(A) 

(B) 

(C) 

(D) 

22. At what temperature, both celsius and Fahrenheit scale shows the same value.
(A) + 40°C (B) +4°C
(C) –100°C (D) –40°C

23. There is a hole in the middle of a copper plate. When heating the plate, diameter of hole would
(A) always increase (B) always decrease
(C) remains the same (D) none of these

24. In which of the following process convection does not take place primarily?
(A) Sea and land breeze
(B) Trade wind
(C) Boiling of water
(D) Warming of glass of bulb due to filament

25. The equatorial and polar regions of the earth receive unequal solar heat. The convection current arising due to this is called.
(A) land breeze (B) sea breeze
(C) trade wind (D) tornado

PARAGRAPH TYPE

PARAGRAPH # 1

Radiation is the transfer of heat by means of electromagnitic waves. To radiate means to send out or spread from a central location. Whether it is light, sound, waves, rays, flower petals, wheel spokes or pain, if something radiates then it protrudes or spreads outward from an origin. The transfer of heat by radiation involves the carrying of energy from an origin to the space surrounding it. The energy is carried by electromagnetic waves and does not involve the movement or the interaction of matter. Thermal radiation can occur through matter or through a region of space that is void of matter (i.e., a vacuum). In fact, the heat received on Earth from the sun is the result of electromagnetic waves traveling through the void of space between the Earth and the sun.

26. Heat energy of the sun is received by the earth, by using the.....

(A) Conduction (B) Convection

(C) Radiation (D) None of these

27. Heat transfer by radiation mainland depends on.....

(A) Nature of body

(B) Its temperature

(C) Surface of body

(D) All of these

28. Radiation is take place

(A) Through vaccum

(B) Through molecular momentum

(C) Through any medium

(D) None of these

PARAGRAPH # 2

Absolute zero is the lowest temperature possible. At a temperature of absolute zero there is no motion and no heat. Absolute zero occurs at a temperature of 0 Kelvin, or -273.15 degrees Celsius, or at -460 degrees Fahrenheit.

29. Which is true about the molecules at 0 K ?

(A) They are moving really fast

(B) They are moving really slowly

(C) There is no motion at 0 K

(D) All of the above are true

30. Why can't there be a t emperature lower than absolute zero.

(A) Because at absolute zero, motion of molecules of a substance almost stops.

(B) Because heat is related to temperature and is the energy of moving particles of matter.

(C) Because of kinetic energy of molecular motion.

(D) Because when you add heat, ice begins to melt and turns into water.

31. What is the value of absolute zero temperature in celsius.

(A) 0 (B) – 273

(C) – 40 (D) 100

MATCH THE COLUMN TYPE

32.

Column-I	**Column-II**
(a) Heat	(p) Measure of hotness or coldness
(b) Temperature	(q)Good absorber
(c) Black surface	(r) Form of energy

(A) a-r, b-p, c-q (B) a-p, b-q, c-r

(C) a-r, b-q, c-p (D) a-q, b-r, c-p

33.

Column-I	**Column - II**
(a) Actual movement of molecules	(p) Convection currents
(b) Rubber, cork, plastic, wood	(q) 100°C
(c) Boiling point of water	(r) Good conductors
(d) Gold, silver, copper, iron	(s) Insulators

(A) a-p, b-s, c-q, d-r (B) a-s, b-q, c-p, d-r

(C) a-p, b-q, c-r, d-s (D) a-r, b-p, c-s, d-q

EXERCISE – II

VERY SHORT ANSWER TYPE

1. Give the name of instrument, which is used for measurement of heat.
2. Write down the example of good and Bad conductors.
3. Name the method of heating of the earth by the sun.
4. What is the freezing point of water?
5. Convert 77°F to °C.
6. Give one condition for heat to flow between two bodies.
7. Write two advantages of use of mercury in thermometer.
8. What are insulators?
9. Write the relation between Celsius and Kelvin scales.
10. Name the thermometer which is used to measure the temperature of human body.

SHORT ANSWER TYPE

1. Write the differences between conduction, convection and radiation.
2. What precautions should we take while using a clinical thermometer?
3. Define the following terms :
   (i) Temperature (ii) Thermometer
   (iii) Conductor of heat (iv) Insulator of heat
4. What do you mean by conduction mode of transfer of heat energy?
5. If difference of temperature between A and B is 5°C, what is the difference in Kelvin's scale?

LONG ANSWER TYPE

1. What is the use of 'kink' in clinical thermometer?
2. Draw labelled diagram of a clinical thermometer and explain its construction.
3. Explain the conduction and write its necessary condition.
4. What are the differences between heat and temperature?
5. Define the lower fixed point and upper fixed point on temperature scales. Give these points on different temperature scales.

TRUE OR FALSE

1. Mercury is a toxic substance.
2. Air is good conductor and water is poor conductor of heat.
3. The transfer heat by radiation does not require any medium.
4. On heating the density of the substance always decreases.
5. The constant movement of water while heating is called convection current.

FILL IN THE BLANKS

1. In solids, generally, heat is transferred by _____.
2. In vacuum, heat energy can travel by the process of_____.
3. Black colour is a _____absorber of heat.
4. The handles of cooking utensils are made of _____.
5. Digital thermometers do not use _____.

NUMERICAL TYPE QUESTIONS

1. If the temperature is given in °C and that is 35°C then find out the temperature in kelvin.

2. If the temperature in Fah renheit is 104° F then find out in °C?

3. How many methods are there for transfer of heat.

4. The temperatue rises by 180°F. What is the rise on celsius scale ?

5. Convert 293K into celsius scale.

Answer Key

EXERCISE–I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	C	C	D	C	B	D	C	C	B	D	D	A	A	A
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	B	A	B	B	A	D	A	D	C	C	D	A	C	A
31	32	33												
B	A	A												

EXERCISE – II

TRUE / FALSE

1. T 2. F 3. T 4. F 5. T

FILL IN THE BLANKS

1. Conduction 2. Radiation 3. Good 4. Insulators
5. mercury

SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : HEAT)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In-Text Examples			
Solved Examples			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

NOTES :

1. In the status, put "completed" only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.

Space for Notes :

MOTION AND TIME 2

Concepts

Introduction

1. *Different types of Motion*
   - *1.1 Translatory motion*
   - *1.2 Rotatory motion*
   - *1.3 Oscillatory Motion*
2. *Distance and Displacement*
   - *2.1 Distance*
   - *2.2 Displacement*
3. *Speed*
4. *Types of speed*
   - *4.1 Uniform Speed (Constant speed)*
   - *4.2 Non Uniform Speed (Variable speed)*
5. *Velocity*
6. *Types of velocity*
   - *6.1 Uniform Velocity*
   - *6.2 Variable Velocity*
   - *6.3 Average Velocity*
7. *Acceleration*
   - *7.1 Types of acceleration*
     - ☛ *Positive acceleration*
     - ☛ *Negative acceleration (retardation)*
8. *Measurement of Time*
   - *8.1 Simple Pendulum*
9. *Graphical representation of motion*
   - *9.1 Distance time graph*
   - *9.2 Speed time graph*
   - *9.3 Velocity time graph*
   - *9.4 Acceleration time graph*

Solved Examples

Exercise – I (SCQ Type)

Exercise – II (Board Pattern Type)

Answer Key

INTRODUCTION

Motion is one of the more common events in your surroundings. You can see motion in natural events such as clouds moving, rain and snow falling and streams of water moving etc. Motion can also be seen in the activities of people who walk, jog or drive various vehicles from place to place. The study of motion is called 'mechanics' It is broken down into two parts, kinematics and dynamics. Kinematics is the "how" of motion, that is, the study of how objects move, without concerning that why they move. Dynamics is the "why" of motion. In dynamics, we are concerned with the causes of motion, which is the study of forces.

Consider a ball that you notice one morning in the middle of a lawn. Later in the afternoon, you notice that the ball is at the edge of the lawn, against a fence and you wonder if the wind or some person moved the ball. You do not know. If the wind blew it at a steady rate, or even if some children kicked it all over the yard. All you know for sure is that the ball has been moved because it is in a different position after some time passed. These are the two important aspects of motion :

(i) A change of position

(ii) The passage of time

Moving involves a change of position during some time period. Motion is the act or process of something changing position. The motion of an object is usually described with respect to a stationary object. Such a stationary object is said to be at '**Rest**'

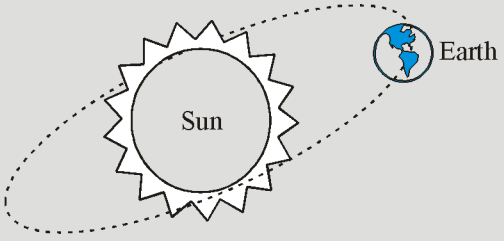
⇒ **Motion** is a change in an object's position with respect to time compared to a fixed object. If you ride in a car, your position changes compared to a tree or an electric pole.

⇒ An object is said to be at **Rest** if it does not change its position with time.

Focus Point

REST AND MOTION ARE RELATIVE TERMS

Imagine that you are traveling in an automobile with another person. You know that you are moving across the land outside the car since you location on the highway changes from one moment to another. Observing your fellow passenger show that there is no change of position. You are in motion relative to the ground but you are not in motion relative to your fellow passenger. The motion of any object or body is the process of a change in position 'relative' to some reference object or location.



When sitting on a chair, your speed is zero relative to Earth but 30 km/s relative to the Sun.

Reference Point

A reference point is a starting point used to describe the position of an object. A reference point is also called the origin.

To describe an object's position, three things must be included in the description :

(i) a reference point (ii) a direction from the reference point (iii) distance from the reference point (the length of the line segment joining the referece point and the object.

1. DIFFERENT TYPES OF MOTION

1.1 TRANSLATORY MOTION

A bus moving on a road, the motion of a rising balloon, the free fall of a stone under gravity, the motion of a cricket ball when it is hit by a batsman are examples of translatory motion. Translatory motion is further classified into rectilinear motion and curvilinear motion. When an object moves along a straight path, its motion is said to be rectilinear. The marching of soldiers on a straight road, the motion of a car on a straight road, the motion of carrom board coin are examples of rectilinear motion. When an object moves along curved path, its motion is called curvilinear. A bus moving on a flyover bridge, a car taking a turn, a football kicked from the ground into the air all have curvilinear motion.

1.2 ROTATORY MOTION

In this type of motion, the object rotates about a fixed axis. The motion of blades of a ceiling fan, the spin motion of a top, the motion of turbine, the motion of the earth around the sun all have circular or rotatory motion. In some cases, the rotatory and translatory motions take place simultaneously. When a bicycle moves, its wheels undergo translatory and rotatory motion.

1.3 OSCILLATORY MOTION

A boy on a swing moves to and fro (back and forth). The motion, such as above, where an object moves to and fro is called oscillatory motion. Other examples of oscillatory motion are the motion of the pendulum of clock, the motion of a needle of a sewing machine, the motion of a piston of an engine etc.

A metallic wire fixed at its ends, when plucked starts moving up and down. This is also an example of oscillatory motion where an object moves to and fro at faster rate. This type of motion is called **Vibratory Motion**. In the stringed instruments, such as guitar, veena, violin etc., the motion of a string is vibratory. The motion of membrane of a drum is also a vibratory motion. It must be noted that during vibratory motion, a change in size and shape takes place.

A motion that repeats itself at regular intervals of time is called **Periodic Motion**. All oscillatory motions are periodic motions. Some rotatory motions are periodic motions. The motion of earth around the sun, the motion of the pendulum of a clock, the rotation of earth about its own axis, the motion of a swing are periodic motions.

A motion repeats itself but not at fixed interval of time is called **Non-Periodic Motion**. A ceiling fan when it is switched off, a drum rolling up or down on an inclined plane, the motion of a wheel of bicycle when brakes applied are all examples of non periodic motion.

2. DISTANCE AND DISPLACEMENT

Distance and displacement are two most commonly used terms that have same dimensions and units. These two terms are often confusing but have entirely different meanings.

2.1 DISTANCE

Distance is defined as the length of the actual path covered by a particle in motion. The unit of distance is centimetre in C.G.S. system and metre in M.K.S. or S.I. system. Following points to remember related to distance.

(i) Distance is a scalar quantity

(ii) Distance depends on the path

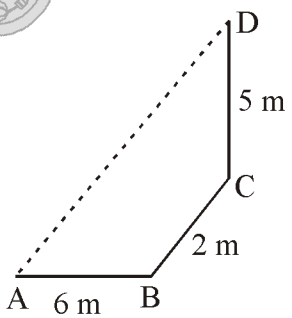
(iii) Distance is always taken positive

2.2 DISPLACEMENT

Displacement is defined as the shortest distance between the initial and final positions of a body. **It is a vector quantity**, whose magnitude is equal to the length of the straight line path from the initial position to the final position and the direction is along the straight line drawn from the initial to the final position.

The distance travelled by a particle depends on the path traced by the particle, whereas the displacement of a particle in motion is independent of the path traced and depends only on the initial and final positions of the particle.

Consider a particle moving along the path ABCD as shown below :



The distance travelled by the particle = 6 + 2 + 5 = 13 m

The displacement is the vector $\overrightarrow{AD}$, whose magnitude is the length of the line segment AD.

Focus Point

- Distance is always greater than or equal to the magnitude of displacement. Distance is exactly equal to displacement

(i) When it follows a straight path without changing its direction.

(ii) When it is in uniform motion.

- Whenever a particle changes its direction of follows a curved path, distance is always greater than or equal to the magnitude of displacement.

3. SPEED

The distance covered by a body in unit time. It is the rate at which the body is moving. It means how fast or slow the body is moving

Mathematicaly,

$$\text{Speed (v)} = \frac{\text{Distance covered by the body(s)}}{\text{Time taken to cover the same distance (t)}}$$

Important points related to speed :

(i) Speed is a scalar quantity

(ii) Speed depends on the path

(iii) Speed gives no idea about the direction of motion of the object.

(iv) Speed can never be negative. In motion, it is taken positive ; at rest, it is zero.

(v) Speed is measured in S.I. units, as mps (meter per second) or **m s^{-1}.**

Now, $\frac{1\text{km}}{1\text{h}} = 1 \times \frac{1000\text{m}}{60 \times 60}$

$= 1 \times \frac{1000}{60 \times 60}$

$= 1 \times \frac{10}{36} = \frac{\mathbf{5}}{\mathbf{18}}\mathbf{m/s}$

Example 1

Suppose an insect crawls and covers a distance of 10m in a time interval of 5 seconds, the speed of the insect

Solution :

$$\text{Speed (V)} = \frac{s}{t} = \frac{10}{5} = 2 \text{ m s}^{-1}$$

Example 2

A car travels at 20 m/s. Express the same speed in km/h.

Solution :

Convert 20 m into km $\left(20\text{m} = \frac{20}{1000}\text{km}\right)$

Convert 1s into hour $\left(1\text{s} = \frac{1}{60 \times 60}\text{h}\right)$

$$\text{Speed} = \left(\frac{\frac{20}{1000}}{\frac{1}{60 \times 60}}\right) = \frac{20 \times 3600}{1000} = 72 \text{ km/h}$$

Example 3

A bus leaves Sikar at 7 PM and reaches Jaipur at 10 PM. The speed of the bus is 40 km/h. What is the distance between Sikar and Jaipur ?

Solution :

Distance = Speed × Time = 40 × 3 = 120 km (Time 10 – 7 = 3 hour)

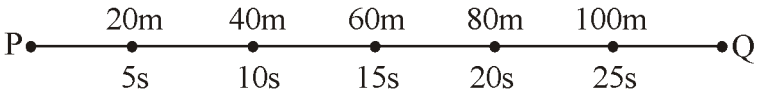
4. TYPES OF SPEED

4.1 UNIFORM SPEED (CONSTANT SPEED)

If a body covers equal distances is equal intervals of time however small these intervals may be, the body is said to be under uniform speed or constant speed.

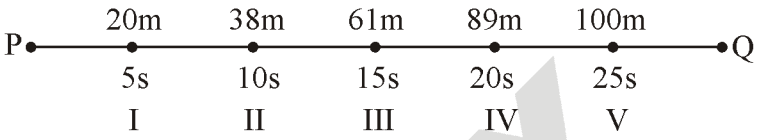
For example : A body start at 'P' and travels 20 m in every 5 seconds, then

$$\text{Uniform speed} = \frac{20}{5} = \frac{40}{10} = \frac{60}{15} = \frac{80}{20} = \frac{100}{25} = 4 \text{ m s}^{-1}$$



4.2 NON UNIFORM SPEED (VARIABLE SPEED)

When a body covers either unequal distances in equal intervals of time or equal distances in unequal intervals of time or both, the body is said to be under nonuniform or variable speed. For example : A body starts at a point 'p' and travels as shown in figure.



Speeds at different intervals

$I = \frac{20}{4} = 4\,m\,s^{-1}$; $II = \frac{38}{10} = 3.8\,m\,s^{-1}$; $III = \frac{61}{15} = 4.07\,m\,s^{-1}$;

$IV = \frac{89}{20} = 4.45\,m\,s^{-1}$; $V = \frac{100}{25} = 4\,m\,s^{-1}$

It can be noticed here, though the average speed is same, the speed itself is not uniform but varying

4.3 AVERAGE SPEED

When a body starts with certain speed and changes its speed after some time and completes the journey. Then the average speed implies the overall rapidity or speed of the body.

Mathematically, Average speed = $\frac{\text{Total distance covered by the body}}{\text{Total time taken by the body}}$

5. VELOCITY

Rate of change of displacement or rate of change of position of a body in a specific or given direction

Mathematically,

$$\text{Velocity (V)} = \frac{\text{Displacement}}{\text{Time}}$$

If someone states that speed of a running boy is 2 m s^{-1}, it is very clear that he covers 2 m in one second. Now the question arises in which direction he is running then only it makes a complete sense and meaning. Therefore, it can be stated he is running with 2 m per second from say 'A' to 'B' or say eastwards.

Important points related to Velocity :

(i) Velocity is a vector quantity

(ii) Velocity can be negative, positive or zero.

(iii) Velocity does not depend on the path, it depends only on the initial position and final position of an object.

(iv) Velocity gives the direction of motion of an object.

(v) Magnitude of the velocity is known as **speed** i.e. 1 km/hr = $\frac{5}{18}$ m / s.

Example 4

An object travels with a velocity of 1.5 m/s eastwards for 2s and then with a velocity of 4 m/s northwards for 1s. What is its final displacement at the end of 3s ?

Solution :

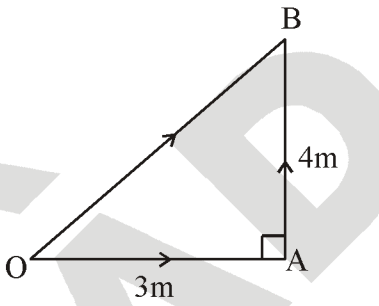
Displacement along OA = velocity × time = 1.5×2 = 3 m

Displacement along AB = velocity × time = 4 × 1 = 4m

Final displacement at the end of 3 s (OB)

OB = $\sqrt{OA^2 + AB^2}$ = $\sqrt{3^2 + 4^2}$

= $\sqrt{9+16}$ = $\sqrt{25}$ = 5m (in the direction of O to B)



6. TYPES OF VELOCITY

6.1 UNIFORM VELOCITY

When a body covers equal distances in equal intervals of time in a specified direction, however small these time intervals may be, the body is said to be moving with a uniform velocity.

Imagine a car is moving along a straight road towards east, with a velocity 60 kmph. Here the uniform velocity implies per each minute it covers a distance of 1 km and for each second it covers a distance of 1/60th km.

A body will have a uniform velocity only if :

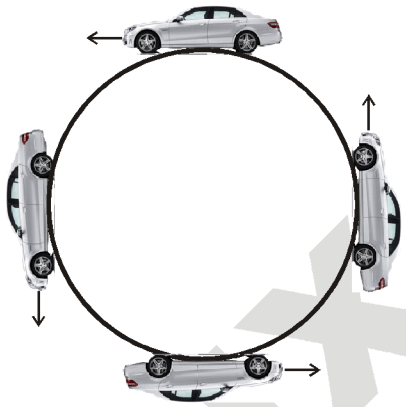
⇒ It covers equal distances in equal intervals of time, i.e., the magnitude does not change.

⇒ Its direction remains the same. If any of the two conditions is not fulfilled, then the body will not be moving with a uniform velocity, but with a variable velocity.

6.2 VARIABLE VELOCITY

When a body covers unequal distances in equal intervals of time in a specified direction or equal distances in unequal intervals of time, but its direction changes then the body is said to be moving with a variable velocity.

Now imagine a car is moving along a circular path with the same velocity, 60 kmph (16.67 m s^{-1}). Here the magnitude of the velocity i.e., 60 kmph is constant but direction is continuously changing. In this case (on circular path) the car is only under uniform speed but not under uniform velocity.



Hence, when the car is covering equal distances is equal intervals of time, in the circular path the car is moving with a variable velocity, as the direction changes continuously.

6.3 AVERAGE VELOCITY

The average displacement of a body per unit time, when the body is actually moving with variable velocity, is called average velocity.

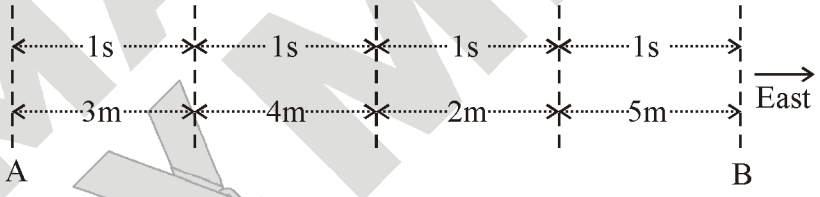


Figure :

In the above figure, the total displacement (total distance travelled) of a body towards east is 3m+4m+2m+5m=15m. The total time is 4 s.

$$\therefore \text{ Average velocity} = \frac{\text{Total displacement}}{\text{Total time taken}} = \frac{14\text{m}}{4\text{s}} = 3.5 \text{ m s}^{-1}$$

NOTE : It is possible to have a moving body with average velocity zero but not with average speed to be zero.

7. ACCELERATION

Mostly the velocity of a moving object changes either in magnitude or in direction or in both when the object moves. Then the body is said to have acceleration. So it is the rate of change of velocity i.e. change in velocity in unit time is said to be acceleration (it is a vector quantity).

Its S.I. unit is m/s^2 and C.G.S. unit is cm/s^2

$$\text{Acceleration, } a = \frac{\text{change in velocity}}{\text{time}} = \frac{v-u}{t} = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$

$$a = \frac{v-u}{t} \Rightarrow v = u + at$$

7.1 TYPES OF ACCELERATION

Positive acceleration

If the velocity of an object increases in the same direction, the object has a positive acceleration.

Eg. A freely falling body.

Negative acceleration (retardation)

If the velocity of a body decreases in the same direction, the body has a negative acceleration or it is said to be retardation.

Eg. A train slows down.

8. MEASUREMENT OF TIME

Time is a phenomenon by which human beings observe and record changes in the environment and the universe. For example : The time between one sunrise and the next is called a day, a month is measured from one new moon to the next, and a year is fixed as the time taken by the earth to complete one revolution of the sun.

Often we need to measure intervals of time which are much shorter than a day. Clocks or watches are the most common time measuring devices.

One of the earliest means of measurement of time was with the help of movement and change in the position of the sun during the day, and the moon during the night. The position of stars also helped in estimating time during night. Jantar Mantar located in Central Delhi is an advanced form of a Sundial. The device used to measure time is known as a **Clock**. The older clocks like the sand clock, the water clock, were some what crude types of clocks. They only gave an approximation of a duration of time. Sundials were more accurate than the sandclocks and the water clocks. Now a days we use a wrist watch or quartz clock. A mechanical wrist watch is provided with a balance wheel which oscillates like a pendulum. In quartz clock, fast vibrating crystals of quartz oscillate at a very precise rate and hence measure time more accurately. The atomic clock is the most scientifically developed clock and therefore, is the most accurate of all. It is the atomic clock maintained at National Physical Laboratory (NPL) at Delhi, which is used to provide beeps before the morning news. These beeps indicate the standard time. This atomic clock is accurate upto a millionth part of a second.

Focus Point

- A body cannot occupy two different positions at the same instant of time.
- **Greenwich Mean Time (GMT)** : It is the time in Greenwich, England. Each time zone was described by how many hours away from GMT it was.
- Sailors used hourglasses filled with sand or powered eggshells to tell time. The powder would take one hour to flow from the top bulb to the bottom bulb.

8.1 SIMPLE PENDULUM

The working of clocks is rather complex. But all of them make use of some periodic motion. One of the most well-known periodic motions is that of a simple pendulum.

A simple pendulum consists of a small metallic ball or a piece of stone suspended from a rigid stand by a thread [see fig. (a)]. The metallic ball is called the bob of the pendulum. Fig. (a) shows the pendulum at rest in its mean position. When the bob of the pendulum is released after taking it slightly to one side, it begins to move to and fro [see fig. (b)]. The to and fro motion of a simple pendulum is an example of a periodic or an oscillatory motion.

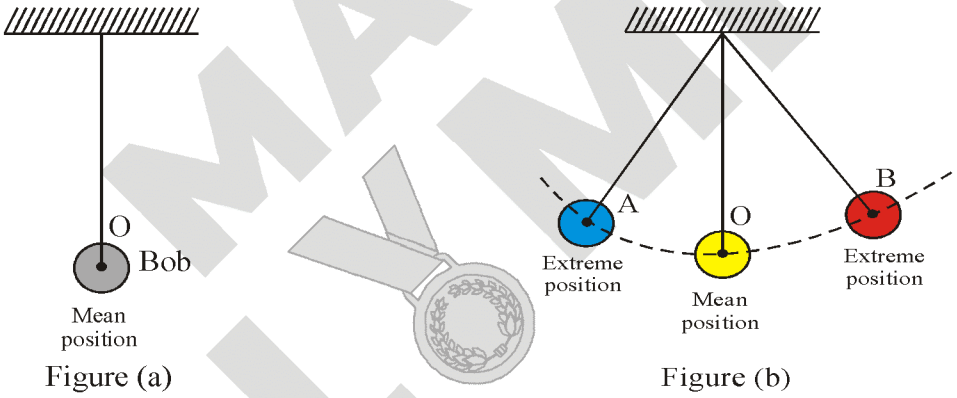


Figure : Oscillatory motion of a pendulum (a) and (b)

The pendulum is said to have completed one oscillation when its bob, starting from its mean position O, moves to A, to B and back to O. The pendulum also completes one oscillation when its bob moves from one extreme position A to the other extreme position B and comes back to A.

The time taken by the pendulum to complete one oscillation is called its time period.

$$\text{Time Period} = \frac{\text{Total time taken}}{\text{No. of oscillations}}$$

Focus Point

Unit of time : The S.I. of unit of time is second (s). Some common used units of time are minute and hour.

1 minute = 60 s ; 1 hour = 60 minutes ; 1 hour = 3600 s

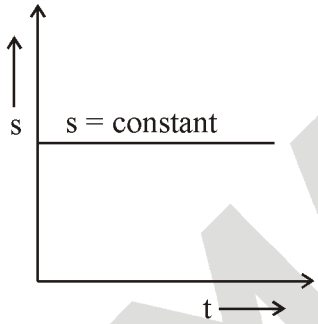
9. GRAPHICAL REPRESENTATION OF MOTION

9.1 DISTANCE TIME GRAPH

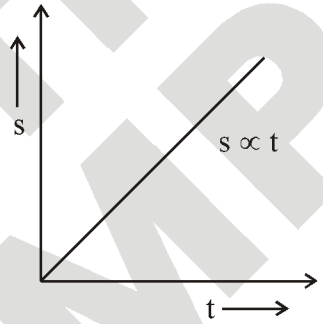
A moving body chages its position continuously with time. The simplest way to describe the motion of a moving body is to draw its distance – time graph.

⇒ Distance is taken on y-axis and time is taken on x-axis.

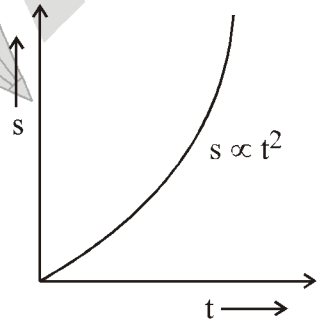
⇒ Distance time graph is always positive, it is always increasing NEVER decreasing.



A body at rest (s = const.)



A body in uniform motion

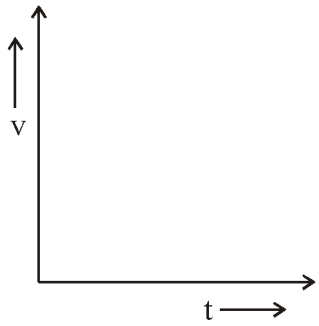


A body in uniformly accelerated motion

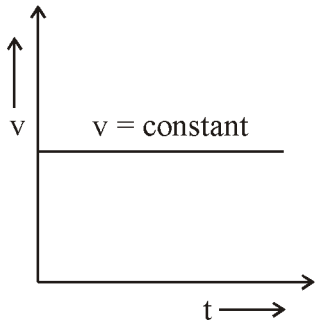
9.2 SPEED TIME GRAPH

⇒ Speed is taken on y-axis and time is taken on x-axis.

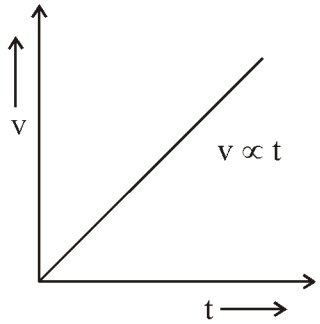
⇒ Speed-time graph is always positive, it can be increasing or decreasing.



A body at rest
(v = 0)



A body in uniform
motion (v = constant)

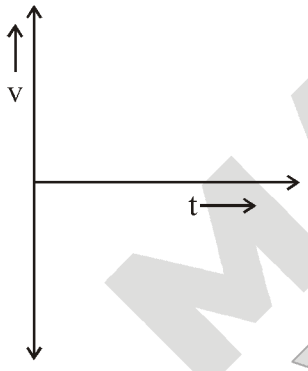


A body in uniformly
accelerated motion
(v = u + at)

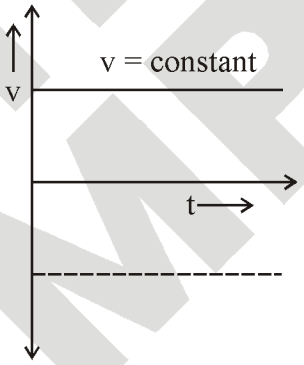
9.3 VELOCITY TIME GRAPH

⇒ Velocity is taken on y-axis and time is taken on x-axis.

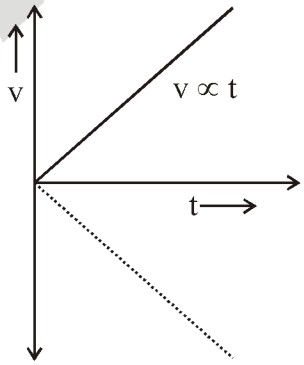
⇒ Velocity time graph can be positive or negative, it can be increasing or decreasing.



A body at rest (v = 0)



A body in uniform motion
(v = constant)

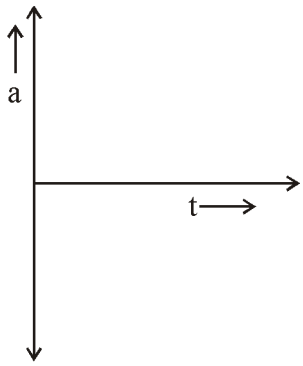


A body in uniformly
accelerated motion
(v = u + at)

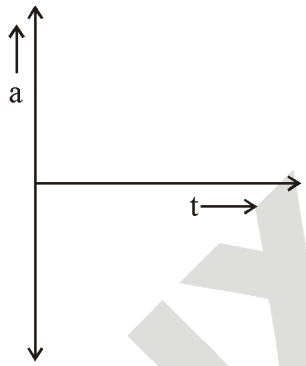
9.4 ACCELERATION TIME GRAPH

⇒ Acceleration is taken on y-axis and time is taken on x-axis.

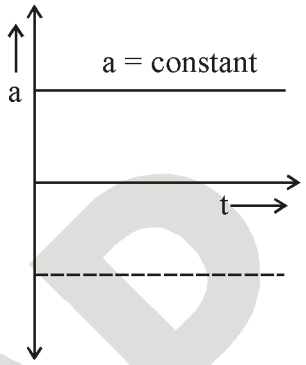
⇒ Acceleration-time graph can be positive or negative, it can be increasing or decreasing.



A body at rest
(a = 0)



A body in uniform
motion (a = 0)



A body in uniform
accelerated motion
(a = constant)

SOLVED EXAMPLES

SE. 1

What is the difference between translatory and rotatory motion ? Give their examples.

Ans. The motion of an object is said to be translatory, if the position of the object is changing with respect to a fixed point or object with time.

For e.g.– a car moving along a road.

The motion of an object is said to be rotatory if the motion of all the particles of the body is circular (i.e., along a circular path) with respect to an imaginary line called the axis of rotation.

For e.g.– A spinning top or hands of a clock, etc.

SE. 2

Which type of motion is periodic as well as oscillatory?

Ans. In case of oscillatory motion, a body as a whole moves back and forth. The motion of a pendulum is an oscillatory motion. Any motion that repeats itself at regular interval of time is called periodic motion. Clock pendulum, repeats its motion after a fixed interval of time. So, motion of pendulum is both periodic as well as oscillatory.

SE. 4

How much distance is travelled by an object if it travels at a constant speed of 60 km/h for 2 hours?

Ans. Time = 2 hours

Speed = 60 km/h

Distance = ?

$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

$$60 = \frac{\text{Distance travelled}}{2}$$

Distance travelled = $60 \times 2 = 120$ km

SE. 4

Find the speed of an object which has travelled 3600 m in 1 minute.

Ans. Distance = 3600 m

Time = 1 min = 60 s

Speed = ?

$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}} = \frac{3600}{60} = 60\ \text{m s}^{-1}$$

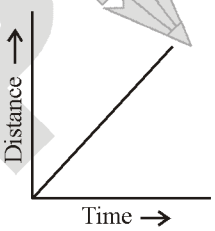
SE. 5

Show the shape of the distance-time graph for the motion in the following cases :

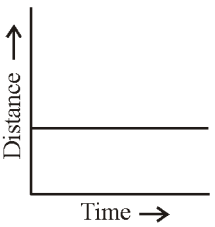
(i) A boy running with a constant speed.

(ii) A boy standing on a side road.

Ans. (i)



(ii)



SE. 6

What was a year as per our ancestors?

Ans. A year was fixed as the time taken by earth to complete one revolution of the sun.

SE. 7

What are x and y-axis in a graph ?

Ans. The horizontal line in a graph is called x-axis and vertical line is called y-axis.

SE. 8

On which axis are dependent variables represented?

Ans. The dependent variables are represented on y-axis.

SE. 9

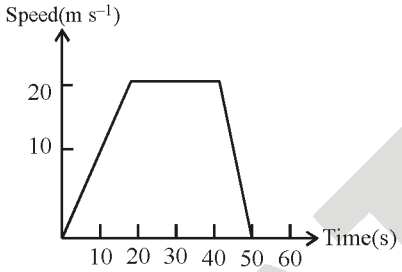
A horse runs a distance of 200 m in 10 s. What is the speed of the horse in (i) m/s (ii) km/hr.

Ans. $\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{200}{10} = 20 \text{ m/s}$

$$\frac{200/1000}{10/3600} = \frac{2}{10} \times \frac{3600}{10} = 72 \text{km/hr}$$

SE. 10

The graph in figure shows the movement of a car over a period of 50 s. What distance was travelled by the car while its speed was decreasing?



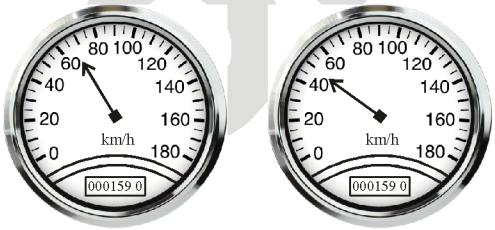
Ans. The speed was decreasing in the time interval between 40 s and 50 s.

Distance travelled = area under the graph between 40 s and 50 s

$$= \frac{1}{2} \times 20 \times 10 = 100 \text{m}$$

SE. 11

Look at the two car speedometers drawn below. Which one is travelling faster?



Car 1 Car 2

Ans. The first car is moving faster than second car.

SE. 12

A train travels at 180 km/h. In one hour the train travels ____km. In four hours it will travel ____km.

Ans. In one hour the train travels 180 km. In four hours it will travel $180 \times 4 = 720$ km.

SE. 13

The Rajdhani express travels at a speed of 80 km/h. The distance between Delhi and Chennai is 2200 km. If it starts from Delhi at 3.00 p.m., what time does it reach Chennai?

Ans. Speed = 80 km/h; Distance = 2200 km.

It covers 80 km in one hour. Therefore, it covers 2200 km in $(2200 \div 80) = 27.5$ or $27\frac{1}{2}$ hours.

It reaches Chennai at 6.30 p.m. the next day.

EXERCISE – I

ONLY ONE CORRECT TYPE

1. A body whose position with respect to surrounding does not change, is said to be in a state of :

(A) Rest

(B) Motion

(C) Vibration

(D) Oscillation

2. In case of a moving body :

(A) Displacement > Distance

(B) Displacement < Distance

(C) Displacement ≥ Distance

(D) Displacement ≤ Distance

3. A distance :

(A) Is always positive

(B) Is always negative

(C) May be positive as well as negative

(D) Is neither positive nor negative

4. A particle is travelling with a constant speed. This means :

(A) Its position remains constant as time passes

(B) It covers equal distances in equal interval of time

(C) Its acceleration is zero

(D) It does not change its direction of motion

5. In 10 minutes, a car with speed of 60 kmh^{-1} travels a distance of :

(A) 6 km (B) 600 km

(C) 10 km (D) 7 km

6. A car acceleration uniformly from 18 km/h to 36 km/h in 5s. The acceleration in ms^{-2} is :

(A) 1 (B) 2

(C) 3 (D) 4

7. The brakes applied to a car produce a negative acceleration of 6 ms^{-2}. If the car stops after 2 seconds, the initial velocity of the car is :

(A) 6 ms^{-1} (B) 12 ms^{-1}

(C) 24 ms^{-1} (D) zero

8. A body is moving with uniform velocity of 10 ms^{-1}. The velocity of the body after 10 s is :

(A) 100 ms^{-1} (B) 50 ms^{-1}

(C) 10 ms^{-1} (D) 5 ms^{-1}

9. In 12 minutes a car whose speed is 35 kmh^{-1} travels a distance of :

(A) 7 km (B) 3.5 km

(C) 14 km (D) 28 km

10. A body is moving along a straight line at 20 ms^{-1} under-goes an acceleration of 4 ms^{-2}. After 2s, its speed will be :

(A) 8 ms^{-1} (B) 12 ms^{-1}

(C) 16 ms^{-1} (D) 28 ms^{-1}

11. A car increases its speed from 36 km/h to 54 km/h in 10s. Its acceleration is :

(A) 30 ms^{-2} (B) 3 ms^{-2}

(C) 18 ms^{-2} (D) 0.5 ms^{-2}

12. The device used to measure speed of a vehicle is :

(A) Odometer (B) Speedometer

(C) Thermometer (D) Voltmeter

13. Light takes $8\frac{1}{2}$ minutes to travel from the sun of the earth. The velocity of light 3×10^5 km s^{-1}. Then the distance of the sun from earth is :

(A) 1.53×10^8 km (B) 3×10^8 km

(C) 4×10^8 km (D) 2.55×10^6 km

14. A clock works on the principle of :

(A) Periodic motion (B) Oscillation

(C) Translation (D) Rotation

15. When a body spin, the body is in :

(A) Rectilinear motion (B) Circular motion

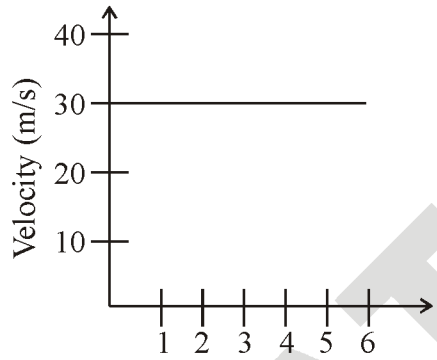
(C) Rotatory motion (D) Periodic motion

16. Motion of a car on a straight path is an example of :

(A) Rectilinear motion (B) Circular motion

(C) Rotatory motion (D) Periodic motion

17. Look at the graph given below carefully and find whether the body is in uniform acceleration :



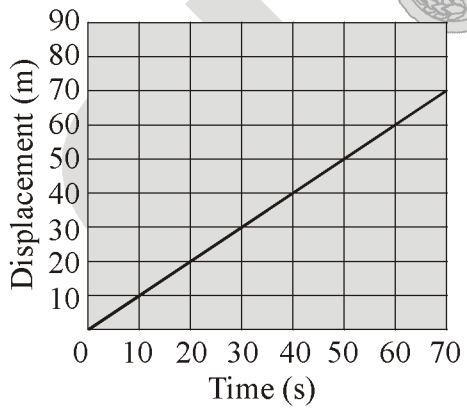
(A) Yes

(B) No

(C) the graph des not give the information that the body is in uniform acceleration

(D) None of these

18. Look at the following graph carefully and find the velocity of the moving body.



(A) 0 m/s (B) 1 m/s

(C) 2 m/s (D) 3 m/s

19. If a body covers unequal distances in equal interval of time, the body is said to be in .....

(A) Uniform acceleration

(B) Non-uniform acceleration

(C) Uniform motion

(D) Non-uniform motion

20. Which of the following is NOT matched correctly

(A) Speedometer : Speed

(B) Odometer : Odour

(C) Anemometer : Wind speed

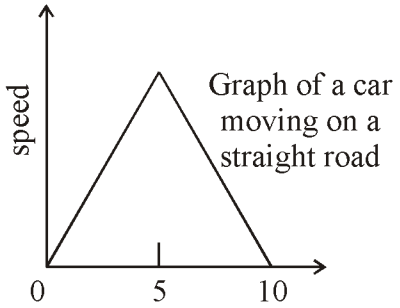
(D) Stopwatch : Time

21. A jet is moving with a speed of 180 km/h. What is its speed in m/s ?

(A) 10 m/s (B) 50 m/s

(C) 200 m/s (D) 500 m/s

22. According to the following graph, what happens to the distance covered by the body form 0-10 minutes



(A) It goes on increasing

(B) It goes on decreasing

(C) It first increases and then decreases.

(D) It first decreases and then increases.

23. What part of second is called nanosecond ?

(A) One hundredth (B) One thousandth

(C) One millionth (D) One billionth

24. The relation between speed and distance is :

(A) Distance = Speed / Time

(B) Distance = Speed × Time

(C) Distance = Time/Speed

(D) None of these

25. Time period of a simple pendulum depends upon :

(A) Weight of bob

(B) Length of pendulum

(C) Both A and B

(D) Neither (A) nor (B)

PARAGRAPH TYPE

PARAGRAPH # 1

The simple pendulum is a mechanical system that sways or moves in an oscillatory motion. This motion occurs in a vertical plane and is mainly driven by the gravitational force. Interestingly, the bob that is suspended at the end of a thread very light somewhat we can say it is even massless. The period of a simple pendulum can be made extended by increasing the length string while taking the measurements from the point of suspension to the middle of the bob. However. it should be noted that if the mass of the bob is changed it will the period remains unchanged. Period is influenced mainly by the position of the pendulum in relation to Earth as the strength of gravitational field is not uniform everywhere.

26. The time taken by the pendulum to complete one oscillation is called its ..... .

(A) Time period (B) Time speed

(C) Distance covered (D) Total time

27. The time taken by a simple pendulum to complete each oscillation remains ..... .

(A) Different (B) Same

(C) Both (A) and (B) (D) None of the above

28. A simple pendulum takes 30s to complete 18 oscillations. What is the time period of the pendulum ?

(A) 166.0 s (B) 0.166 s

(C) 16.6 s (D) 1.66 s

PARAGRAPH # 2

We deal with the distance-time graph while studying the motion of bodies. If we record distance and time for the motion of a body and plot the same data on a rectangular graph, we will obtain a distance-time graph corresponding to the motion of that body. A distance-time graph shows how for an object has travelled in a given time. It is a simple line graph that denotes distance versus time findings on the graph.

29. The distance moved per unit time is known as

(A) Speed (B) Displacement

(C) Velocity (D) Acceleration

30. When a body covers equal distance in equal interval of time, it is said to be in :

(A) Average speed

(B) Uniform motion

(C) Non-uniform motion

(D) Speed

31. On which axis is dependent variable represented ?

(A) X-axis

(B) Y-axis

(C) Any axis

(D) Depends on the data

MATCH THE COLUMN TYPE

32.

Column I	Column II
(a) When a body changes its position with time	(P) Non-uniform motion
(b) Interval between two events	(Q) Motion
(c) SI unit of speed	(R) Time
(d) Unequal distance in equal interval of time	(S) Metre per second

(A) a – P, b – Q, c – R, d – S

(B) a – Q, b – R, c – P, d – S

(C) a – Q, b – R, c – S, d – P

(D) a – S, b – P, c – Q, d – R

33.

Column I	Column II
(a) Day	(P) Second
(b) Month	(Q) Metre
(c) Time	(R) The time from one sunrise to the next
(d) Distance	(S) One new moon to the next new moon

(A) a – R, b – S, c – P, d – Q

(B) a – S, b – R, c – Q, d – P

(C) a – P, b – Q, c – R, d – S

(D) a – R, b – Q, c – P, d – S

Space for Notes :

EXERCISE – II

VERY SHORT ANSWER TYPE

1. Give the name of device which measures time.
2. Give the term used for the time taken by a pendulum to complete one oscillation.
3. What is the shape of distance-time graph for a body moving with uniform motion.
4. Define speed.
5. Name the device which records the speed of a moving vehicle.
6. What type of motion is possessed by a body, when it moves unequal distances in equal intervals of time or vice-versa ?
7. Given one example of periodic motion.
8. Convert 54 km/h into m/s.
9. What do you mean by zero speed ?
10. Give example of any situation showing translatory motion.

SHORT ANSWER TYPE

1. Explain the following terms with respect to a pendulum : time period, oscillation and mean position.
2. A car is moving on a hill station and cover the distance as per the data given. Read the following data and construct a distance-time graph on a graph paper.

Time (in minutes)	Distance (in km) From the starting point
10	5
20	10
30	15
40	20
50	25

3. Define the following terms ;
   (a) Non-uniform motion
   (b) Speed
4. What do you mean by average speed ?
5. A car travels a distance of 270 kilometer in $4\frac{1}{2}$ hours. Find its speed.

LONG ANSWER TYPE

1. Explain the sundial, water clock and sand clock with diagram.
2. Write down difference between distance and displacement.
3. There are bodies in motion which execute two or more types of motion at the same time. Give two examples and explain.
4. Explain the statement "Rest and motion are relative" with example.
5. What is the advantage of distance-time graph?

TRUE / FALSE TYPE

1. The time required to complete one oscillation depends on the mass of the string of simple pendulum.
2. The direction of motion and the speed of a body in uniform motion do not change.
3. Acceleration in uniform circular motion is constant.
4. The graph of distance Vs time is a straight line for non-uniform motion.
5. Measuring time is more difficult than measuring length .

FILL IN THE BLANKS TYPE

1. _____is a motion in which a body repeats the motion at equal intervals of time.
2. The time taken by a pendulum to complete one oscillation is called its _____
3. When the distance travelled by a body at fixed intervals of time is not the same, it is said to be in _____.
4. To ascertain the distance travelled by the vehicle, an _____is fitted along with the speedometer.
5. The distance covered by an object in a unit time is known as the _____of the object.

Space for Notes :

Answer Key

EXERCISE–I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	D	A	B	C	A	B	C	A	D	D	B	A	A	C
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	B	B	D	A	B	A	D	B	B	A	B	D	A	B
31	32	33												
B	C	A												

EXERCISE – II

TRUE / FALSE

1. F 2. F 3. F 4. F 5. F

FILL IN THE BLANKS

1. Periodic motion 2. Time period 3. Non uniform motion 4. Odometer

5. Speed

SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : MOTION AND TIME)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In-Text Examples			
Solved Examples			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

NOTES :

1. In the status, put "completed" only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.

Space for Notes :

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