SURA'S

Science

IX - Standard

Based on the latest Syllabus and updated New Textbook

Salient Features :

- Guide as per the latest Textbook
- Complete Solutions to Textbook Exercises.
- Exhaustive Additional Question in all Units.
- Quarterly Exam - 2019 [QY-2019], Half Yearly Exam - 2019 [HY-2019] are incorporated in appropriate sections.
- Quarterly Exam Question Paper, Half Yearly Exam Question Papers are given.

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NOTE FROM PUBLISHER

It gives me great pride and pleasure in bringing to you **Sura's Science Guide** for **9th Standard**. It is prepared as per the New Syllabus and New Textbook.

This guide encompasses all the requirements of the students to comprehend the text and the evaluation of the textbook.

- Additional questions have been provided exhaustively for clear understanding of the units under study.

In order to learn effectively, I advise students to learn the subject section-wise and practice the exercises given. It will be a teaching companion to teachers and a learning companion to students.

Though these salient features are available in this Guide, I cannot negate the indispensable role of the teachers in assisting the student to understand the subject thoroughly.

I sincerely believe this guide satisfies the needs of the students and bolsters the teaching methodologies of the teachers.

I pray the almighty to bless the students for consummate success in their examinations.

Subash Raj, B.E., M.S.
- Publisher
Sura Publications

All the Best

CONTENTS

UNIT
01

PHYSICS

MEASUREMENT

LEARNING OBJECTIVES

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

- Understand the fundamental and derived quantities and their units.
- Know the rules to be followed while expressing physical quantities in SI units.
- Get familiar with the usage of scientific notations.
- Know the characteristics of measuring instruments.
- Use vernier caliper and screw gauge for small measurements.
- Find the weight of an object using a spring balance.
- Know the importance of accurate measurements.

TEXT BOOK EXERCISES

I. Choose the correct answer :

1. Choose the correct one. *[QY - 2019]*

(a) mm < cm < m < km (b) mm > cm > m > km

(c) km < m < cm < mm (d) mm > m > cm > km

[Ans : (a) mm < cm < m < km]

2. Rulers, measuring tapes and metre scales are used to measure

(a) mass (b) weight (c) time (d) length

[Ans : (d) length]

3. 1 metric ton is equal to

(a) 100 quintals (b) 10 quintals

(c) 1/10 quintals (d) 1/100 quintals **[Ans : (b) 10 quintals]**

4. Which among the following is not a device to measure mass?

(a) Spring balance (b) Beam balance

(c) Physical balance (d) Digital balance

[Ans : (a) Spring balance]

II. Fill in the blanks :

1. Metre is the unit of _____. **[Ans : length]**
2. 1 kg of rice is weighed by _____. **[Ans : beam balance]**
3. Thickness of a cricket ball is measured by _____. **[Ans : vernier caliper]**
4. Radius of a thin wire is measured by _____. **[Ans : screw gauge]**
5. A physical balance measures small differences in mass up to _____. **[Ans : 1mg or less]**

III. State whether true or false. If false, correct the statement :

1. The SI unit of electric current is kilogram.

Ans. False.

Correct statement : The SI unit of electric current is **ampere**.

2. Kilometre is one of the SI units of measurement.

Ans. True.

3. In everyday life, we use the term weight instead of mass.

Ans. True.

4. A physical balance is more sensitive than a beam balance.

Ans. True.

5. One Celsius degree is an interval of 1K and zero degree Celsius is 273.15 K.

Ans. True.

6. With the help of vernier caliper we can have an accuracy of 0.1 mm and with screw gauge we can have an accuracy of 0.01 mm.

Ans. True.

IV. Match the following :

1.

Length	kelvin
Mass	metre
Time	kilogram
Temperature	second

Ans.

Length	metre
Mass	kilogram
Time	second
Temperature	kelvin

2.

Screw gauge	Vegetables
Vernier caliper	Coins
Beam balance	Gold ornaments
Digital balance	Cricket ball

Ans.

Screw gauge	Coins
Vernier caliper	Cricket ball
Beam balance	Vegetables
Digital balance	Gold ornaments

V. Assertion and reason type questions :

Mark the correct answer as :

(a) Both A and R are true but R is not the correct reason.
(b) Both A and R are true and R is the correct reason.
(c) A is true but R is false.
(d) A is false but R is true

1. **Assertion (A) :** The scientifically correct expression is "The mass of the bag is 10 kg"

Reason (R) : In everyday life, we use the term weight instead of mass.

[Ans : (a) Both A and R are true but R is not the correct reason]

2. **Assertion (A) :** 0º C = 273.16 K. For our convenience we take it as 273 K after rounding off the decimal.

Reason (R) : To convert a temperature on the Celsius scale we have to add 273 to the given temperature.

[Ans : (b) Both A and R are true and R is the correct reason]

3. **Assertion (A) :** Distance between two celestial bodies is measured in terms of light year.

Reason (R) : The distance travelled by the light in one year is one light year.

[Ans : (d) A is false but R is true]

Assertion : Distance between two celestial bodies is measured in terms of **astronomical unit.**

VI. Answer very briefly :

1. Define measurement.

Ans. Measurement is the processes of comparison of the given physical quantity with the known standard quantity of the same nature.

2. Define standard unit. **[*QY - 2019*]**

Ans. Unit is the quantity of a constant magnitude which is used to measure the magnitudes of other quantities of the same nature.

3. What is the full form of SI system?

Ans. International System of Units.

4. Define least count of any device. **[*HY - 2019*]**

(i) The smallest length which can be measured by metre scale is called least count.

(ii) Least count of the instrument = $\frac{\text{Value of one main scale division}}{\text{Total number of vernier scale division}}$

Least count = [Pitch / No. of head scale divisions]

5. What do you know about pitch of screw gauge?

Ans. Pitch of the screw gauge is the distance between two successive screw threads. It is measured by the ratio of distance travelled on the pitch scale to the number of rotations of the head scale.

Pitch = [Distance travelled on the pitch scale / Number of rotations of the head scale]

6. Can you find the diameter of a thin wire of length 2 m using the ruler from your instrument box?

Ans. No, I can not find the diameter of a thin wire of length 2 m using the ruler.

VII. Answer briefly :

1. Write the rules that are followed in writing the symbols of units in SI system.

[*QY - 2019*]

Ans. (i) Units named after scientists are written in lower case.
Eg. joule, kelvin and newton.

(ii) Symbols for the units are always written in lower case.
Eg. m, kg and s.

(iii) However, the symbols for the units derived from the names of scientists are written in capital letters.
Eg. C (Celsius), N (newton) and J (joule).

(iv) Symbols are not followed by a full stop.
Eg. 75 cm and not 75 cm.

(v) Symbols are never written in plural.
Eg. 100 kg, not as 100 kgs.

2. Write the need of a standard unit.

Ans. A Standard Unit is needed to maintain uniformity in measurements like length, weight, size and distance. Eg: Standard Unit of length is metre.

3. Differentiate mass and weight. **[*HY - 2019*]**

Ans.

Sl. No.	Mass	Weight
1.	Fundamental quantity	Derived quantity
2.	Has magnitude alone – scalar quantity	Has magnitude and direction – vector quantity
3.	It is the amount of matter contained in a body	It is the normal force exerted by the surface on the object against gravitational pull
4.	Remains the same	Varies from place to place
5.	It is measured using physical balance	It is measured using spring balance
6.	Its unit is kilogram	Its unit is newton

4. How will you measure the least count of vernier caliper?

Ans. Least Count or L.C. is the minimum reading or value that can be measured with a measuring tool or device.

VIII. Answer in detail :

1. Explain a method to find the thickness of a hollow tea cup.

Ans. Step 1 : The Pitch, Least count and the type of zero error of the screw gauge are determined.

Step 2 : The given cup is placed in between two studs.

Step 3 : The head screw using the ratchat arrangement is freely rotated until the given cup is held firmly, but not tightly.

Step 4 : Pitch scale reading (PSR) by the head scale and head scale coincidence (HSC) with the axis of the pitch scale, are found.

Step 5 : The readings are recorded and the experiment for different positions of the given cup is repeated.

Step 6 : The thickness of the cup is calculated using the formula P.S.R+(HSC×L.C)

Step 7 : Then the average of the last column of the table. is found.

Hence the thickness of a hollow tea cup = _____ mm.

2. How will you find the thickness of a one rupee coin?

Ans. Step 1 : The Pitch, Least count and the type of zero error of the screw gauge are determined.

Step 2 : The given coin is placed in between two studs.

Step 3 : The head screw using the ratchat arrangement is freely rotated until given one rupee coin is held firmly, but not tightly.

Step 4 : Pitch scale reading (PSR) by the head scale and head scale coincidence (HSC) with are axis of the pitch scale are found.

Step 5 : The reading are recorded and the experiment for different positions of the given coin is repeated.

Step 6 : The thickness of the coin is computed using the formula P.S.R+(HSC×L.C)

Step 7 : Then the average of the last column of the table is found.

S. No.	P.S.R. (mm)	HSC (division)	CHSC = HSC ± ZC (Division)	CHSR = CHSC × LC (mm)	Total reading =PSR + CHSR (mm)
1.					
2.					
3.					

mean = _____ mm

Hence the thickness of a one rupee coin = _____ mm

IX. Numerical Problems :

1. Inian and Ezhilan argue about the light year. Inian tells that it is 9.46×10^{15} m and Ezhilan argues that it is 9.46×10^{12} km. Who is right? Justify your answer.

Solution : (Inian is correct)

Light travels 3×10^8 m in one second or 3 Lakhs kilometre in one second.

In one year we have 365 days.

The total number of second in one year is equal to $365 \times 24 \times 60 \times 60$

Distance travelled by light in 1 year $= (3.153 \times 10^{7)} \times (3 \times 10^{8)}$

$= \mathbf{9.46 \times 10^{15}\ m.}$

2. The main scale reading while measuring the thickness of a rubber ball using Vernier caliper is 7 cm and the Vernier scale coincidence is 6. Find the radius of the ball.

Solution :

MSR = 7 cm
VC = 6 cm
LC = 0.1 mm = 0.1 cm
Diameter = DR = MSR + (VC × LC)
= 7 + 0.06 cm
Diameter D = 7.06 cm

$$\text{Radius R} = \frac{D}{2} = \frac{7.06}{2} = 0.035 \text{ m}$$

The radius of the ball = **0.0353 m.**

3. Find the thickness of a five rupee coin with the screw gauge, if the pitch scale reading is 1 mm and its head scale coincidence is 68.

Solution :

PSR = 1 mm $= 1 \times 10^{-3}$ m
HSC = 68
LC = 0.01 mm $= 0.01 \times 10^{-3}$ m
Total reading = PSR + (HSC × LC)
$\therefore$ Thickness of the five rupee coin = $1 \times 10^{-3} + (68 \times 0.01 \times 10^{-3})$ m
$\therefore$ Thickness of the five rupee coin = 1.68×10^{-3} m = **1.68 mm**

4. Find the mass of an object weighing 98 N.

Solution :

$W = mg$
$W = 98$ N
$g = 9.8$ m/s^2

$$m = \frac{W}{g} = \frac{98}{9.8} = \textbf{10 kg.}$$

Intext Activities

ACTIVITY - 1

Using Vernier caliper find the outer diameter of your pen cap.

Aim : To find the outer diameter of the pen cap.

Materials required : Vernier caliper, pen cap.

Solution :

S. No.	MSR (cm)	VSR (division)	VSR = (VSC × LC)	Diameter = MSR + VSR
1.	9	34	34 × 0.01 = 0.34	9 + 0.34 = 9.34
2.	9	36	36 × 0.01 = 0.36	9 + 0.36 = 9.36
3.	9	35	35 × 0.01 = 0.35	9 + 0.35 = 9.35
				Mean D = **9.35 cm**

Result : The outer diameter of the pen cap = **9.35 cm** *[End of the activity]*

ACTIVITY - 2

Determine the thickness of a single sheet of your science textbook with the help of a Screw gauge.

S. No.	P.S.R. (mm)	HSC (division)	HSR (mm) HSR = HSC × LC	TR (mm) t = PSR + HSR mm
1.	0	29	0.29	0.29
2.	0	30	0.30	0.30
3.	0	31	0.31	0.31
		Mean thickness 't' of the sheet = **0.30**		

LC = Least Count
PSR = Pitch Scale Reading
HSC = Head Scale Coincidence
HSR = Head Scale Reading
TR = Total Reading

Result : The thickness of the single sheet is = **0.30mm.**

[End of the activity]

Government Exam Questions

2 Mark

1. Match the following.

Column I	Column II
Electric Current	kg
Luminous intensity	ampere
Temperature	candela
Mass	K

Ans.

Column I	Column II
Electric Current	ampere
Luminous intensity	candela
Temperature	K
Mass	kg

7 Mark

1. Explain a method to find the diameter of spherically body. *[QY - 2019]*

Ans. Procedure :

(i) Find the least count of the Vernier caliper.
(ii) Find the zero correction of the Vernier caliper.
(iii) Fix the object firmly in between the two lower jaws of the Vernier.
(iv) Measure the main scale reading and the Vernier scale coincidence.
(v) Repeat the experiment by placing the jaws of the Vernier at different position of the object.
(vi) Use the below formula to find the diameter of the object.

Diameter of object = d = MSR + (VC × LC) ± ZC (cm)

Additional Questions

I. Choose the correct answer :

1. Length is _____
(a) The amount of matter in an object
(b) The amount of space an object takes up.
(c) The distance between two points.
(d) The amount of stuff in an object **[Ans : (c) The distance between two points]**

2. Mass is _____.
(a) The distance between two points
(b) The distance between three points
(c) The amount of matter contained in an object
(d) The amount of space an object occupies.
[Ans : (c) The amount of matter contained in an object]

3. Unit used to measure length
(a) metre (b) litre
(c) gram (d) cubic metre (m^3) **[Ans : (a) metre]**

4. Unit which is used to measure mass
(a) ml (b) l (c) cm (d) gram
[Ans : (d) gram]

5. How many metres are there in 1 nanometer?
(a) 10^{-10}m (b) 10^{-9}m (c) 10^{9}m (d) 10^{10}m
[Ans : (b) 10^{-9}m]

6. What unit will you use to measure the length of our classroom?
(a) km (b) m (c) cm (d) mm
[Ans : (b) m]

7. The Kelvin is the basic unit of _____
(a) temperature (b) mass (c) length (d) volume
[Ans : (a) temperature]

8. _____ consists of 'U' shape metal frame
(a) Screw gauge (b) Vernier caliper (c) Beam balance (d) Spring balance
[Ans : (a) screw gauge]

9. Least count of a vernier caliper is _____ cm.
(a) 1 (b) 0.1 (c) 0.01 (d) 0.001
[Ans : (c) 0.01]

10. If no object is placed on the hook, then the pointer of the spring balance reads _____
(a) 3 (b) 2 (c) 1 (d) 0 **[Ans : (d) 0]**

11. SI unit of mass and weights are _____.
(a) kg, N (b) N, kg (c) K, N (d) N, K
[Ans : (a) kg, N]

12. Units named after scientists _____.
(a) lower case (b) upper case
(c) both (a) and (b) (d) neither (a) or (b) **[Ans : (a) lower case]**

13. An instrument that is used to measure the diameter of a cricket ball is _____.
(a) Screw guage (b) Meter scale
(c) Vernier caliper (d) Spring balance
[Ans : (a) Vernier caliper]

14. Distance between Chennai and Kanyakumari can be found in

(a) Kilometres (b) Metres (c) Centimetres (d) Millimetres.

[Ans : (a) Kilometres]

II. Fill in the blanks :

1. The precision of vernier calipers is _____ mm. **[Ans : (a) 0.1mm]**

2. The gravity accelerates any object, the distance fallen is proportional to _____.

[Ans : time squared]

3. SI unit of electric current is _____. **[Ans : ampere]**

4. Larger unit for measuring time is _____. **[Ans : millennium]**

5. The value of an astronomical unit is _____. **[Ans : 1.496×10^{11}m]**

6. Mass is a _____ quantity. **[Ans : scalar]**

III. State whether true or false. If false, correct the statement :

1. The precision of screw guage is 0.001cm.

Ans. True.

2. The unit of amount of substance is candela

Ans. False.

Correct statement : The unit of amount of substance is **mole**.

3. The symbol for the units derived from the names of scientists are written in capital letter

Ans. True.

4. Yard was used as the unit of length.

Ans. True.

5. Micron is also known as micro-metre

Ans. True.

6. A vernier caliper using the scale invented by Galileo.

Ans. False.

Correct statement : A vernier caliper using the scale invented **Pierre Vernier**.

7. The SI unit of mass is kg.

Ans. True.

8. Weight has both magnitude and direction.

Ans. True.

IV. Match the following :

1.

Column - I	Column - II
FPS	Metre, kilogram and second
CGS	Foot, pound and second
MKS or SI	centimetre, gram and second

Ans.

Column - I	Column - II
FPS	Foot, pound and second
CGS	centimetre, gram and second
MKS or SI	Metre, kilogram and second

2.

Column I	Column II
10 years	1 year
10 centuries	1 century (100 years)
10 decades	1 millennium
365.24 days	1 decade

Ans.

Column I	Column II
10 years	1 decade
10 centuries	1 millennium
10 decade	1 century (100 years)
365.24 days	1 year

3.

Column I	Column II
Angle	m
Solid angle	radian
Length	s
Time	steradian

Ans.

Column I	Column II
Angle	radian
Solid angle	steradian
Length	m
Time	s

4.

Column I	Column II
Millimeter	10^{-15}m
Nanometer	10^{-3}m
Angstrom	10^{-9}m
Fermi	10^{-10}m

Ans.

Column I	Column II
Millimeter	10^{-3}m
Nanometer	10^{-9}m
Angstrom	10^{-10}m
Fermi	10^{-15}m

5.

Column I	Column II
Temperature	Beam balance
Mass	Ruler
Length	Digital clock
Time	Thermometer

Ans.

Column I	Column II
Temperature	Thermometer
Mass	Beam balance
Length	Ruler
Time	Digital clock

V. Assertion and reason type :

1. **Assertion (A) :** Light year and wave length both measure distance
Reason (R) : Both have dimensions of time.
(a) Both A and R are true but R is not the correct explanation of A.
(b) Both A and R are true and R is the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true. **[Ans : (c) A is true but R is false]**

2. **Assertion (A) :** Density is a derived physical quantity
Reason (R) : Density cannot be derived from the fundamental physical quantities.
(a) Both A and R are true but R is not the correct explanation of A.
(b) Both A and R are true and R is the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true. **[Ans : (c) A is true but R is false]**
Correct statement : Density can be derived from **mass and volume**.

3. **Assertion (A) :** Mass, Length and Time are fundamental physical quantities.
Reason (R) : They are independent of each other.
(a) Both A and R are true but R is not the correct explanation of A.
(b) Both A and R are true and R is the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.
[Ans : (b) Both A and R are true and R is the correct explanation of A]

4. **Assertion (A) :** The SI system of units is the improved system of units for measurement.
Reason (R) : The SI unit of mass is kilogram.
(a) Both A and R are true but R is not the correct reason.
(b) Both A and R are true and R is the correct reason.
(c) A is true but R is false.
(d) A is false but R is true.
[Ans : (b) Both A and R are true and R is the correct reason]

5. **Assertion (A) :** The skill of estimation is important for all of us in our daily life.
Reason (R) : The skill of estimation reduces our consumption of time.
a) Both A and R are true but R is not the correct reason.
b) Both A and R are true and R is the correct reason.
c) A is true but R is false.
d) A is false but R is true.
[Ans : (b) Both A and R are true and R is the correct reason]

VI. Comprehensive type :

(a) The speed of a body gives us an idea of how slow or fast that a body is moving. Speed of a body is the distance travelled by it per unit time. The SI unit of speed is metre per second. It is a scalar quantity. The speed of a running cab at any instant of time is shown by an instrument called, 'speedometer' and the distance travelled by a car is measured by another instrument called, 'odometer'.

1. **Which of the following is not correct unit of speed?**
(a) cm/s (b) m/s (c) km/h (d) km/s.
[Ans : (d) km/s]

2. **If the distance travelled by the cab in 3 hours is 120 km, then its speed will be**
(a) 40 m/s (b) 40 km/s (c) 40 km/h (d) 40 km/min
[Ans : (c) 40 km/h]

3. **The formula for finding the speed of the cab is**
(a) Distance = speed × time (b) velocity = distance × time
(c) time = distance × velocity (d) None of these.
[Ans : (a) Distance = speed × time]

(b) **Read the passage and answer the questions given below.**

Mass is the amount of matter contained in an object. Measurement of mass helps us to distinguish between lighter and a heavier body. Beam balance, spring balance and electronic balance are used to measure mass of different objects. The SI unit of mass is kilogram (kg). But different units are used to measure the mass of different objects depending upon their weight. e.g. weight (mass) of a tablet is measured in milligrams (mg), weight of a student is measured in kilogram (kg), and weight of a truck with goods is measured in metric tons. 1 metric ton is equal to 10 quintals and 1 quintal is equal to 100 kg. 1 gram is equal to 1000 mg.

1. **The value of 1 metric ton is equal to**
(a) 1000 kg (b) 10 quintals (c) 1000,000 g (d) 100 kg
[Ans : (a) 1000 kg (or) (b) 10 quintals]

2. How will you measure weight of a tablet?

(a) kg (b) g (c) mg (d) none of these.

[Ans : (c) mg]

VII. Answer very briefly :

1. Write the units which are used to measure long distances.

Ans. km, AU, light year, parsec.

2. Define Astronomical unit.

Ans. AU is defined as the average distance between the earth and the sun.

$1\ AU = 1.496 \times 10^{11} m$.

3. Define light year.

Ans. The distance travelled by light in one year in vacuum.

$1\ \text{light year} = 9.46 \times 10^{15} m$.

4. Convert the temperature from Fahrenheit into Celsius & Kelvin.

Ans.

°F to °C	°F to K
$\frac{(F-32)}{1.8}$	$\left[\frac{(F-32)}{1.8}+273\right]$

5. Convert 100°C into Kelvin.

Ans. 100 + 273 = 373 K. ie. °C + 273

6. Convert 112°F into K.

Ans. $\frac{(F-32)}{1.8}+273 = \frac{(112-32)}{1.8}+273 = \frac{80}{1.8}+273 =$ 44.44 + 273 = 317.44 K

7. Write the principle of screw gauge.

Ans. (i) When a screw is rotated in a nut, the distance moved by the tip of the screw is directly proportional to the number of rotations given.

(ii) Hence principle of the screw is considered as the principle of screw gauge.

8. What are the kinds of units?

Ans. 1. Fundamental or basic units
2. Derived units

9. Give some examples of fundamental units.

Ans. The examples of fundamental units are kg for mass, m for length, s for time.

10. Give some examples of derived units.

Ans. The units of area, volume, density.

11. What is the standard unit of weight?

Ans. Newton is the standard unit of weight.

12. What is the standard unit of mass?

Ans. Kilogram is the standard unit of mass.

13. Define Mass.

Ans. Mass is the amount of matter contained in a body.

14. Define Weight.

Ans. The force with which the earth attracts a body towards its center is called weight.

15. What is the SI unit of temperature?

Ans. Kelvin is the SI unit of temperature.

16. What is the measuring unit of the thickness of a plastic carry bag?

Ans. 1 micron = 10^{-6}m (or) µm.

VIII. Answer briefly :

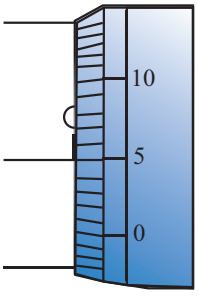
1. Write temperature conversion.

Ans. Temperature Conversion (Exact)

From	To Fahrenheit	To Celsius	To Kelvin
Fahrenheit (°F)	°F	$\left(\frac{F-32}{1.8}\right)$	$\left[\frac{F-32}{1.8}+273\right]$
Celsius (°C)	(C × 1.8) + 32	°C	°C + 273
Kelvin (K)	[(K – 273) × 1.8] + 32	K – 273	K

2. Write about the positive zero error in screw gauge instrument.

Ans. When the plane surface of the screw and the opposite plane stud on the frame are brought into contact, if the zero of the head scale lies below the pitch scale axis, the zero error is positive. For example, the 5th division of the head scale coincides with the pitch scale axis, then the zero error is positive and is given by Z.E = + (n × LC) where 'n' is the head scale coincidence. In this case, Zero error = + (5 × 0.01) = 0.05 mm. So the zero correction is – 0.05 mm.



Positive Zero error

3. Write SI units for the fundamental quantity.

Ans.

Basic Quantity	Unit
Length	metre
Mass	kilogram
Time	second
Electric current	ampere
Temperature	kelvin
Amount of substance	mole
Luminous intensity	candela

4. Convert the following units in metre.

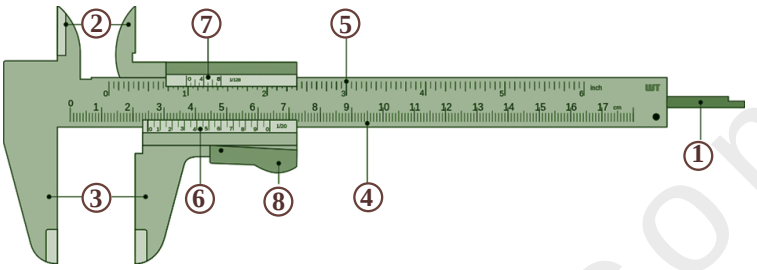
Ans.

Smaller units	Value in metre
centimetre (cm)	10^{-2} m
millimetre (mm)	10^{-3} m
micron or µm	10^{-6} m
nanometre (nm)	10^{-9} m
angstrom (Å)	10^{-10} m
fermi (f)	10^{-15} m

5. Draw and mark the parts of vernier caliper

Ans. PARTS Marked in the Vernier caliper

1. Lower fixed jaw
2. Upper fixed jaw
3. Lower movable jaw
4. Vernier scale
5. Retainer
6. Main scale
7. Depth probe.



IX. Numerical Problems :

1. A piece of iron of volume 40cm^3 whose density is 6.8g/cm^3. Find the mass of iron.

Solution :

Given, density of iron, D = 6.8g/cm^3

volume of iron, V = 40 cm^3

mass of iron, M = V × D [∴ mass = volume × density]

$$= 40\ \cancel{cm^3} \times \frac{6.8g}{\cancel{cm^3}}$$

$$m = 272.0g.$$

2. Solve : The mass of 40 apples in a box is 5 kg.

(i) Find the mass of a dozen of them.

(ii) Express the mass of one apple in gram.

Solution :

(i) 40 apple = 5 kg = 5000 g

$$1 \text{ apple} = \frac{500\cancel{0}}{4\cancel{0}}$$

1 apple = 125 g

∴ 1 dozen = 12 apples

12 apples = 125 × 12 g

12 apples = 1500 g.

(ii) 40 apples = 5000 g

$$1 \text{ apple} = \frac{5000}{40} \text{ g}$$

1 apple = 125 g

The mass of 1 apple = 125 g.

X. Answer in detail :

1. How will you find Zero Error of the screw gauge?

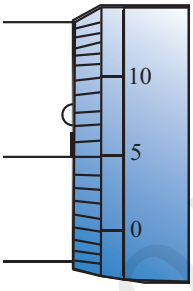
Ans. Zero Error of a screw gauge :

When the plane surface of the screw and the opposite plane stud on the frame area brought into contact, if the zero of the head scale coincides with the pitch scale axis there is no zero error.

Positive zero error :

When the plane surface of the screw and the opposite plane stud on the frame are brought into contact, if the zero of the head scale lies below the pitch scale axis, the zero error is positive. For example, the 5th division of the head scale coincides with the pitch scale axis, then the zero error is positive and is given by

Z.E = + (n × LC) where 'n' is the head scale coincidence. In this case, Zero error = + (5 × 0.01) = 0.05mm. So the zero correction is – 0.05 mm.



Positive Zero error

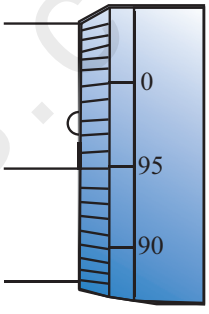
Negative zero error :

When the plane surface of the screw and the opposite plane stud on the frame are brought into contact, if the zero of the head scale lies above the pitch scale axis, the zero error is negative.

For example, the 95th division coincides with the pitch scale axis, then the zero error is negative and is given by

$$ZE = -(100 - n) \times LC$$
$$ZE = -(100 - 95) \times LC$$
$$= -(5 \times 0.01)$$
$$= -0.05 \text{ mm}$$

The zero correction is **+ 0.05 mm**.



Negative Zero Error

2. How will you find Zero Error of Vernier Caliper? Explain.

Ans. Zero error :

(i) Unscrew the slider and move it to the left, such that both the jaws touch each other. Check whether the zero marking of the main scale coincides with that of the Vernier scale.

(ii) If they are not coinciding with each other, the instrument is said to posses zero error. Zero error may be positive or negative.

(iii) If the zero mark of the Vernier is shifted to the right, it is called positive error.

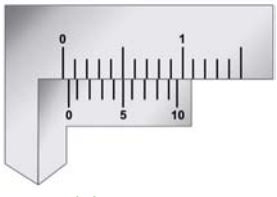
(iv) On the other hand, if the Vernier zero is shifted to the left of the main scale zero marking, then the error is negative.

Positive zero error :

(i) From the figure you can see that zero of the vernier scale is shifted to the right of zero of the main scale.

(ii) In this case the reading will be more than the actual reading.

(iii) Hence, this error should be corrected. In order to correct this error, find out which vernier division is coinciding with any of the main scale divisions.



Positive zero error

(iv) Here, fifth vernier division is coinciding with a main scale division.

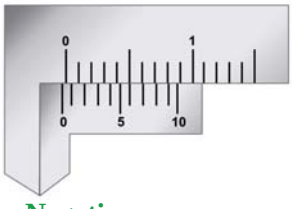
(v) So, positive zero error = +5 × LC = +5 x 0.01 = 0.05 cm.

Negative zero error :

(i) You can see that zero of the vernier scale is shifted to the left of the zero of the main scale.

(ii) So, the obtained reading will be less than the actual reading.

(iii) To correct this error we should first find which vernier division is coinciding with any of the main scale divisions, as we found in the previous case.



Negative zero error

(iv) In this case, you can see that sixth line is coinciding. But, to find the negative error, we can count backward (from 10).

(v) So, the 4th line is coinciding. Therefore, negative zero error

$= -4 \times LC = -4 \times 0.01 = -0.04$ cm.

3. Write short note on the following :

(i) Common balance

(ii) Physical balance

(iii) Digital balance

(iv) Spring balance

Ans. Common (beam) balance :

Common beam balance

A beam balance compares the sample mass with a standard reference mass (Standard reference masses are 5g, 10g, 20g, 50g, 100g, 200g, 500g, 1kg, 2kg, 5kg). This balance can measure mass accurately up to 5g

Physical balance :

Physical balance

This balance is used in labs and is similar to the beam balance but it is a lot more sensitive and can measure mass of an object correct to a milligram. The standard reference masses used in this physical balance are 10 mg, 20 mg, 50 mg, 100 mg, 200 mg, 500 mg, 1 g, 2g, 5 g, 10 g, 20 g, 50 g, 100g, and 200 g.

Digital balance :

Digital balance

Nowadays, for accurate measurements digital balances are used, which measure mass accurately even up to a few milligrams, the least value being 10 mg (Figure 1.11). This electrical device is easy to handle and commonly used in jewellery shops and labs.

Spring balance :

Spring balance

This balance helps us to find the weight of an object. It consists of a spring fixed at one end and a hook attached to a rod at the other end. It works by 'Hooke's law' which states that the addition of weight produces a proportional increase in the length of the spring. A pointer is attached to the rod which slides over a graduated scale on the right. The spring extends according to the weight attached to the hook and the pointer reads the weight of the object on the scale.

UNIT

02

MOTION

LEARNING OBJECTIVES

Students will be able to

- List the objects which are at rest and which are in motion around them.
- Understand distance and displacement.
- Determine the displacement and distance covered by an object describing a circular path .
- Classify the motion of vehicles as uniform motion and non-uniform motion. distinguish between speed and velocity.
- Relate accelerated and unaccelerated motion.
- Deduce the equations of motion of an object from velocity – time graph.
- Write the equations of motion for a freely falling body.
- Understand the nature of circular motion.
- Identify centripetal force and centrifugal force in day to day life.

TEXT BOOK EXERCISES

I. Choose the correct answer :

1. The area under velocity – time graph represents the

(a) velocity of the moving object. (b) displacement covered by the moving object.
(c) speed of the moving object. (d) acceleration of the moving object.

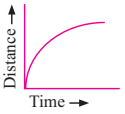
[Ans : (b) displacement covered by the moving object]

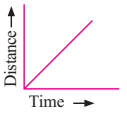
2. Which one of the following is most likely not a case of uniform circular motion?

(a) Motion of the Earth around the Sun.
(b) Motion of a toy train on a circular track.
(c) Motion of a racing car on a circular track.
(d) Motion of hours' hand on the dial of the clock.

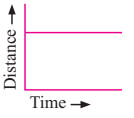
[Ans : (c) Motion of a racing car on a circular track]

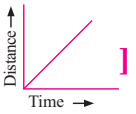
3. Which of the following graph represents uniform motion of a moving particle?

(a) 

(b) 

(c) 

(d) 

[Ans : (b) 

]

4. The centrifugal force is

(a) a real force.
(b) the force of reaction of centripetal force.
(c) a virtual force.
(d) directed towards the centre of the circular path. **[Ans : (c) a virtual force]**

II. Fill in the blanks :

1. Speed is a _____ quantity whereas velocity is a _____ quantity. ***[HY - 2019]*** **[Ans : Scalar, Vector]**

2. The slope of the distance – time graph at any point gives _____. **[Ans : Speed]**

3. Negative acceleration is called _____. **[Ans : retardation (or) deceleration]**

4. Area under velocity – time graph shows _____. **[Ans : displacement]**

III. State whether true or false. If false, correct the statement :

1. The motion of a city bus in a heavy traffic road is an example for uniform motion.

Ans. False.

Correct statement : The motion of a city bus in a heavy traffic road is an example for **non-uniform motion**.

2. Acceleration can get negative value also.

Ans. True.

3. Distance covered by a particle never becomes zero but displacement becomes zero.

Ans. True.

4. The velocity – time graph of a particle falling freely under gravity would be a straight line parallel to the *x* axis.

Ans. False.

Correct statement : The velocity - time graph of a particle **moving at uniform velocity,** would be straight line parallel to the *x* axis.

5. If the velocity – time graph of a particle is a straight line inclined to X-axis then its displacement – time graph will be a straight line.

Ans. True.

IV. Assertion and reason type questions :

Mark the correct choice as:

(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If assertion is false but reason is true.

1. Assertion : The accelerated motion of an object may be due to change in magnitude of velocity or direction or both of them..

Reason : Acceleration can be produced only by change in magnitude of the velocity. It does not depend the direction.

[Ans : (c) If assertion is true but reason is false.]

2. Assertion : The Speedometer of a car or a motor-cycle measures its average speed.

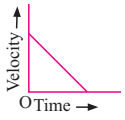
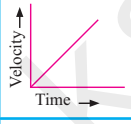
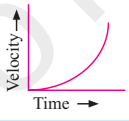
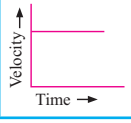
Reason : Average velocity is equal to total displacement divided by total time taken. **[Ans : (d) Assertion is false but reason is true]**

3. **Assertion** : Displacement of a body may be zero when distance travelled by it is not zero.

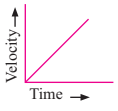
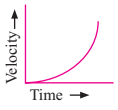
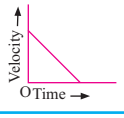
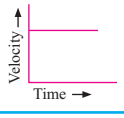
Reason : The displacement is the shortest distance between initial and final position.

[Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion]

V. Match the Following :

	List I		List II
1.	Motion of a body covering equal distances in equal intervals of time	**A**	
2.	Motion with non uniform acceleration	**B**	
3.	Constant retardation	**C**	
4.	Uniform acceleration	**D**	

Ans.

	List I		List II
1.	Motion of a body covering equal distances in equal intervals of time	**A**	
2.	Motion with non uniform acceleration	**B**	
3.	Constant retardation	**C**	
4.	Uniform acceleration	**D**	

VI. Answer briefly :

1. Define velocity.

Ans. (i) Velocity is the rate of change of displacement. It is the displacement with unit time. It is a vector quantity. The SI unit of velocity is ms^{-1}.

(ii) Thus, Velocity = Displacement / time taken.

2. Distinguish distance and displacement. [QY - 2019]

Ans.

Sl. No.	Distance	Displacement
1	The actual length of the path travelled by a moving body irrespective of the direction	The change in position of a moving body in a particular direction
2	It is a Scalar quantity	It is a Vector quantity

3. What do you mean by uniform motion?

Ans. An object is said to be in uniform motion if it covers equal distances in equal intervals of time howsoever big or small these time intervals may be.

4. Compare speed and velocity.

Ans.

Sl. No.	Speed	Velocity
1.	It is the rate of change of distance with respect to time	It is the rate of change of displacement with respect to time
2.	It is a scalar quantity having magnitude only	It is a vector quantity having both magnitude and direction
3.	Speed is velocity without a particular direction	Velocity is speed in a particular direction
4.	It is measured in ms^{-1} in SI system	It is also measured in ms^{-1} in a particular direction in SI system
5.	Speed in any direction would be a positive quantity, since the distance in any direction is a positive quantity.	Velocity can get both positive and negative values. If velocity in one direction is assumed to be positive then the velocity in the opposite direction would be a negative quantity. Velocity can get zero value also.

5. What do you understand about negative acceleration?

Ans. If velocity decreases with time the value of acceleration is negative.

Note : Negative acceleration is called retardation or deceleration.

6. Is the uniform circular motion accelerated? Give reasons for your answer.

Ans. When an object is moving with a constant speed along a circular path, the change in velocity is only due to the change in direction. Hence it is accelerated motion.

7. What is meant by uniform circular motion? Give two examples of uniform circular motion.

Ans. When an object moves with constant speed along a circular path, the motion is called uniform circular motion.

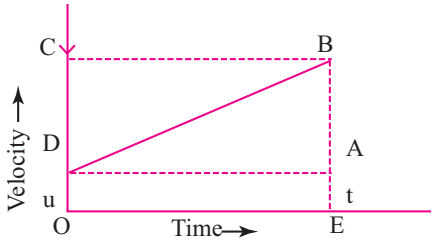
Example :

1. The Earth moves around the Sun in the uniform circular motion.
2. The Moon moves in uniform circular motion around the Earth.

VII. Answer in detail :

1. Derive the equations of motion by graphical method. [QY - 2019]

Ans. Equations of motion from velocity – time graph:



Graph shows the change in velocity with time of a uniformly accelerated object. The object starts from the point D in the graph with velocity u. Its velocity keeps increasing and after time t it reaches the point B on the graph.

The initial velocity of the object = u = OD = EA

The final velocity of the object = v = OC = EB

Time = t = OE = DA

Also from the graph we know that, AB = DC

1. First equation of motion :

By definition, acceleration = change in velocity / time

= (final velocity – initial velocity)/time

= (OC – OD) / OE

= DC / OE

a = DC / t

DC = AB = at

From the graph EB = EA + AB

$$v = u + at \longrightarrow (1)$$

This is first equation of motion.

2. Second equation on of motion :

From the graph the distance covered by the object during time t is given by the area of quadrangle DOEB

s = area of the quadrangle DOEB

= area of the rectangle DOEA + area of the triangle DAB

= (AE × OE) + (1/2 × AB × DA)

$$s = ut + \tfrac{1}{2}(at^2) \longrightarrow (2)$$

This is the second equation of motion.

3. Third equation of motion :

From the graph the distance covered by the object during time, t is given by the area of the quadrangle DOEB. Here DOEB is a trapezium. Then,

s = area of trapezium DOEB

= ½ × sum of length of parallel side × distance between parallel sides

= ½ × (OD + BE) × OE

s = ½ × (u + v) × t

since $a = (v - u) / t$ or $t = (v - u) / a$

Therefore s = ½ × (v + u) × (v – u) / a

$2as = v^2 - u^2$

$$v^2 = u^2 + 2as \longrightarrow (3)$$

This is the third equation of motion.

2. Explain different types of motion.

Ans. Different types of motion :

(i) Linear motion : The motion of an object along a straight line is known as linear motion. **Ex :** Car moving on a straight road.

(ii) Circular motion : The motion of an object is a circular path is known as circular motion. **Ex :** Earth revolving around the sun.

(iii) Oscillatory motion : Repetitive to and fro motion of an object at regular interval of time is called as oscillatory motion. **Ex :** Motion of pendulum of a clock.

(iv) Random motion : The disordered or irregular motion of a body is called random motion. **Ex :** Movement of fish under water.

VIII. Exercise Problems :

1. A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of $10 ms^{-2}$, with what velocity will it strike the ground? After what time will it strike the ground?

Ans. Here we have

Initial velocity, u = 0
Distance, s = 20 m
Acceleration, a = $10 m/s^2$
Final velocity, v = ?
Time, t = ?

a) Calculation of final velocity, v

We know that, $v^2 = u^2 + 2as$

$v^2 = 0 + 2 \times 10\ m/s^2 \times 20\ m$

$v^2 = 400\ m^2/s^2$

$= \sqrt{400 m^2 / s^2}$

$v = 20\ m/s$

b) Calculation of time, t

We know that, $v = u + at$

$20\ m/s = 0 + 10\ m/s^2 \times t$

$t = \frac{20 m / s^2}{20 m / s} = 2s$

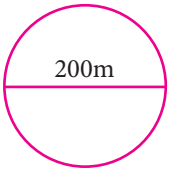
$\therefore$ Ball will strike the ground at a velocity of $20\ ms^{-1}$

Time taken to reach the ground = **2s.**

2. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 m and 20 s?

Ans. Here we have

Diameter = 200 m
$\therefore$ Radius = 200 m/2 = 100 m
Time of one rotation = 40 s
Time after 2m 20 *s* = 2 × 60 *s* + 20 *s* = 140 *s*
Distance after 140 *s* = ?
Displacement after 140 *s* = ?
Circular track with diameter of 200m



We know that, velocity along a circular path $= \frac{\text{circumference}}{\text{time}}$

$$v = \frac{2\pi r}{40s}$$

$$v = \frac{2 \times 3.14 \times 100\text{m}}{40s}$$

$$v = \frac{628\text{ m}}{40s}$$

$$v = 15.7\text{ m/s}$$

a) Distance after 140 s

We know that, distance = velocity × time

$\Rightarrow$ Distance = 15.7 m/s × 140 s

= 2198 m

b) Displacement after 2 min 20 s i.e, in 140 s

We know that, distance = velocity × time

Since, rotation in 40 s = 1

$\therefore$ Rotation in 1 s $= \frac{1}{40}$

$\therefore$ Rotation in 140 s $= \frac{1}{40} \times 140 = 3.5$

$\therefore$ In 3.5 rotation athlete will be just at the opposite side of the circular track. i.e. at a distance equal to the diameter of the circular track which is equal to 200m

$\therefore$ Distance covered in 2min 20 s = **2198 m**

Displacement after 2min 20 s = **200 m**.

3. A racing car has a uniform acceleration of 4ms^{-2}. What distance it covers in 10s after the start?

Ans. Here we have

Acceleration, a = 4 m/s^2

Initial velocity u = 0

Time t = 10 s

Distance (s) covered = ?

We know that, $s = ut + \frac{1}{2} at^2$

$s = (0 \times 10s) + [\frac{1}{2} \times 4\text{ m/s}^2 \times (10\text{ s})^2]$

$= \frac{1}{2} \times 4\text{ m/s}^2 \times 100\text{ s}^2$

= 2 × 100 m = **200 m**

Thus, racing car will cover a distance of 200 m after start in 10s with given acceleration.

Intext Activities

ACTIVITY - 1

Look around you. You can see many things: a row of houses, large trees, small plants, flying birds, running cars and many more. List the objects which remain fixed at their position and the objects which keep on changing their position.

Solution :

1. Row of houses, large trees, small plants are the examples, of immovable objects.
2. Flying birds, running cars and buses are the examples of movable objects.

Activity to be done by the students themselves

ACTIVITY - 2

Tabulate the distance covered by a bus in a heavy traffic road in equal intervals of time and do the same for a train which is not in an accelerated motion. From your table what do you understand?

The bus covers unequal distance in equal intervals of time but the train covers equal distances in equal intervals of time.

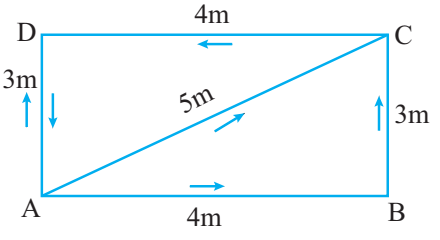
Solution :

Distance covered by a BUS in a heavy traffic	Distance covered by a TRAIN which is NOT in an accelerated motion
In first 10 minutes = 1 km. Next 10 minutes = 2 km. Next 10 minutes = 1.5 km	In first 5 minutes = 2 km. Next 5 minutes = 2 km. Next 5 minutes = 2 km
Covers unequal distance in equal intervals of time.	Covers equal distances in equal intervals of time
Such motion is called Non Uniform Motion.	Such motion is called Uniform Motion.

ACTIVITY - 3

Observe the motion of a car as shown in the figure and answer the following questions:

Compare the distance covered by the car through the path ABC and AC. What do you observe? Which path gives the shortest distance to reach D from A? Is it the path ABCD or the path ACD or the path AD?



Solution :

1. Distance covered by the car through the path ABC = 4m + 3m = 7 m. and AC = 5 m. The distance covered by the car through the path ABC is large compared to AC.
2. The shortest distance to reach D from A is path AD = 3m.
3. The total distance covered by the car ABCDA = 14 m. It finally reaches to A.

ACTIVITY - 4

Take a large stone and a small eraser. Stand on the top of a table and drop them simultaneously from the same height? What do you observe? Now, take a small eraser and a sheet of paper. Drop them simultaneously from the same height. What do you observe? This time, take two sheets of paper having same mass and crumple one of the sheets into a ball. Now, drop the sheet and the ball from the same height. What do you observe?

Solution :

Both the stone and the eraser have reached the surface of the Earth almost at the same time.

The eraser reaches first and the sheet of paper reaches later.

The paper crumpled into a ball reaches ground first and plain sheet of paper reaches later, although they have equal mass. It is because of air resistance. The magnitude of air resistance despends on the area of object exposed to air. So the sheet of paper reaches later.

Government Exam Questions

1 Mark

1. Unit of acceleration is ***[QY - 2019]***

(a) ms^{-1} (b) ms^{-2} (c) ms (d) ms^2

[Ans : (b) ms^{-2}]

2. The magnitude of the centripetal force is given by (F = _____)

(a) $\frac{mv^2}{r}$ (b) $\frac{v^2}{r}$ (c) $\frac{2\pi}{T}$ (d) ma

[Ans : (a) $\frac{mv^2}{r}$]

3. In India the voltage of alternating current used for domestic purpose is _____.

(a) 50V (b) 5V (c) 220V (d) 110V

[Ans : (c) 220V]

2 Mark

1. A sound is heard 5 s later than the lightning is seen in the sky on a rainy day. Find the distance of location of lightning? Given the speed of sound = 346 ms^{-1}

Solution :

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

Distance = Speed × Time = 346 × 5 = 1730 m

Thus, the distance of location of lightning is 1730 m.

Additional Questions

I. Choose the correct answer :

1. A particle is moving in a circular pattern of radius *r*. The displacement after half a circle would be

(a) zero (b) πr (c) $2r$ (d) $2\pi r$

[Ans : (c) 2*r*]

2. In which of the following cases of motions, the distance moved and the magnitude of displacement are equal?

(a) If the car is moving in the straight road.
(b) If the car is moving in a circular road.
(c) The Earth is revolving around the sun.
(d) The pendulum is moving to and fro

[Ans : (a) If the car is moving in the straight road]

3. A body is thrown vertically upward with velocity *u*, the greatest height h to which it will rise is

(a) $u^2/2g$ (b) u^2/g (c) u/g (d) $u/2g$

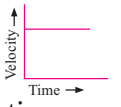
[Ans : (a) $u^2/2g$]

4. If the displacement of an object is proportional to square of time, then the object moves with

(a) uniform velocity (b) uniform acceleration
(c) increasing acceleration (d) decreasing acceleration

[Ans : (b) uniform acceleration]

5. From the given *v–t* graph, u can be inferred that the object is



(a) in uniform motion (b) at rest
(c) in non-uniform motion (d) moving with uniform acceleration

[Ans : (a) in uniform motion]

6. Area under *v–t* graph represents a physical quantity which has the unit.

(a) m^2 (b) m (c) m^3 (d) ms^{-1}

[Ans : (b) m]

7. m/s^2 is the unit of

(a) distance (b) displacement (c) velocity (d) acceleration

[Ans : (d) acceleration]

8. The rate of change of displacement

(a) speed (b) velocity (c) acceleration (d) retardation

[Ans : (b) velocity]

9. A scalar quantity has

(a) magnitude only (b) direction only
(c) both (d) none **[Ans : (a) magnitude only]**

10. When an object undergoes acceleration

(a) there is always an increase in its velocity
(b) there is always an increase in its speed
(c) a force always acting on it.
(d) all of the above **[Ans : (c) a force always acting on it]**

11. **A body is projected up with an initial velocity *u* m/s. It goes up to a height, '*h*' metres in '*t*' seconds time. Then it comes back at the point of projection. Considering negligible air resistance, which of the following statement is true?**

(a) the acceleration is zero
(b) the displacement is zero
(c) the average velocity is $2h/t$
(d) the final velocity is $2u$ when body reaches projection point

[Ans : (b) the displacement is zero]

12. **A car accelerates at 1.5m/s^2 in a straight road. How much is the increase in velocity in 4s.**

(a) 6 m/s (b) 4 m/s (c) 3 m/s (d) 2.66 m/s

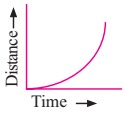
[Ans : (a) 6 m/s]

13. **The slope of the distance time curve is steeper / greater is the _____**

(a) velocity (b) acceleration (c) displacement (d) speed

[Ans : (d) speed]

14. **The given graph represents motion with _____ speed.**



(a) uniform (b) non uniform
(c) constant (d) none

[Ans : (b) non uniform]

15. **The relation between displacement and time is given by the equation of**

(a) $v^2 = ut + at$ (b) $s = ut + \frac{1}{2}at^2$ (c) $v = s/t$ (d) $v^2 = u^2 + 2as$

[Ans : (b) $s = ut + \frac{1}{2} at^2$]

16. **A body moves in a uniform circular motion**

(a) It is moving with constant velocity
(b) its acceleration is zero
(c) the body has an acceleration
(d) none of the above **[Ans : (a) It is moving with constant velocity]**

17. **Speed of the body in particular direction can be called**

(a) acceleration (b) displacement
(c) velocity (d) distance **[Ans : (c) velocity]**

18. **Statement A : Uniform circular motion is a case of accelerated motion**
Statement B : In third equation of motion we do not have the term time

(a) Statement B is true, A is false (b) Statement A is true, B is false
(c) neither statement A nor B is true (d) both are true **[Ans : (d) both are true]**

19. **Which of the following is correct about uniform circular motion**

(i) direction of motion is continuously changed
(ii) direction of motion is not changed
(iii) speed and direction both remain constant
(iv) speed is constant but direction is changing

(a) ii & iii are correct (b) i, ii & iii are correct
(c) i & iv are correct (d) all of these

[Ans : (c) i & iv are correct]

20. **Which of the quantities have the same SI unit?**
(a) speed, velocity (b) acceleration, time
(c) velocity, time (d) velocity, acceleration
[Ans : (a) speed, velocity]

21. **Rest and motion of body are**
(a) non relative (b) not related (c) relative (d) none
[Ans : (c) relative]

22. **An ant moves from one corner of a room diagonally to the opposite corner. If the dimensions of the hall are 8m × 6m, the displacement of the ant is**
(a) 10m (b) 14m (c) 28m (d) 2m
[Ans : (a) 10m]

23. **The displacement covered by a second hand of radius 'r' in a clock after one revolution is**
(a) 360° (b) 0 (c) $3r$ (d) $2r$ **[Ans : (b) 0]**

24. **A man leaves his house at 6.30 a.m. for a morning walk and returns back at 7.30 a.m. after covering 4 km. Displacement covered by him is _____.**
(a) 2 km (b) zero (c) 8 km (d) 4 km
[Ans : (b) zero]

25. **A body is said to be in non uniform motion if it travels**
(a) equal distance in unequal interval of time
(b) equal distance in equal interval of time
(c) unequal distance in unequal interval of time
(d) unequal distance in equal interval of time.
[Ans : (d) unequal distance in equal interval of time]

26. **A quantity which has both magnitude and direction is**
(a) scalar (b) distance (c) vector (d) moving body
[Ans : (c) vector]

27. **A bus accelerating with $4ms^{-2}$ changes its speed from $60ms^{-1}$ to a certain value in 5s. The final speed is**
(a) 40 m/s (b) 25 ms^{-1} (c) 60 ms^{-1} (d) 30 ms^{-1}
[Ans : (a)] 40 m/s

28. **A quantity has a value of $-16ms^{-2}$. It is the**
(a) acceleration of an object (b) velocity of an object
(c) retardation of an object (d) speed of an object
[Ans : (c) retardation of an object]

29. **A boy throws a ball up and catches it when the ball falls back. In which part of the motion the ball is accelerating?**
(a) during downward motion (b) when the ball comes to rest
(c) during upward motion (d) when the boy catches the ball.
[Ans : (a) during downward motion]

30. **Choose the correct option.**
(a) distance is a scalar, velocity is a vector, acceleration is a vector
(b) distance is a vector, velocity is a scalar, acceleration is a vector
(c) distance is a vector, velocity is a vector, acceleration is a vector
(d) distance is a scalar, velocity is a vector, acceleration is scalar
[Ans : (a) distance is a scalar, velocity is a vector, acceleration is a vector]

31. **If a moving body comes to rest, then its acceleration is**
(a) positive (b) negative
(c) zero
(d) all of these depending upon initial velocity. **[Ans : (b) negative]**

32. **If the velocity of a body changes uniformly from *u* to *v* in time *t*, the sum of average velocity and acceleration is**
(a) $\frac{(u+v)}{t}$ (b) $\frac{(v-u)}{t}$ (c) $\frac{2u}{t}$ (d) $\frac{2v}{t}$
[Ans : (d) $\frac{2v}{t}$]

33. **Acceleration is defined as the rate of change of**
(a) distance (b) velocity (c) speed (d) displacement
[Ans : (b) velocity]

34. **When an object undergoes acceleration**
(a) there is always an increase in its velocity
(b) there is always an increase in its speed
(c) a force always acting on it.
(d) all the above **[Ans : (c) a force always acting on it]**

35. **The equation v = u + at gives information as**
(a) velocity is a function of time
(b) velocity is a function of position
(c) position is a function of time
(d) position is a function of time and velocity
[Ans : (a) velocity is a function of time]

36. **Which of the following can determine the acceleration of a moving object.**
(a) area of velocity time graph (b) slope of velocity time graph
(c) area of distance time graph (d) slope of distance time graph
[Ans : (b) slope of velocity time graph]

37. **What is the slope of the body when it moves with uniform velocity?**
(a) positive (b) negative
(c) zero (d) may be positive or negative
[Ans : (c) zero]

38. **If a body starts from rest, what can be said about the acceleration of body?**
(a) positively accelerated (b) negative accelerated
(c) uniform accelerated (d) none of the above
[Ans : (a) positively accelerated]

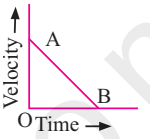
39. **When a body moves uniformly along the circle then**
(a) its velocity changes but speed remains the same
(b) its speed changes but velocity remains the same
(c) both speed and velocity changes
(d) both speed and velocity remains same
[Ans : (a) its velocity changes but speed remains the same]

40. **Distance travelled by a freely falling body is proportional to**
(a) mass of the body
(b) square of the acceleration due to gravity
(c) square of the time of fall
(d) time of fall **[Ans : (c) square of the time of fall]**

41. **If the displacement - time graph of a particle is parallel to the time axis, then velocity of the particle is.**

(a) infinity (b) unity
(c) equal to acceleration (d) zero **[Ans : (d) zero]**

42. **In the velocity time graph, AB shows that the body has**



(a) uniform acceleration
(b) non-uniform retardation
(c) uniform speed
(d) initial velocity OA & is moving with uniform retardation.

[Ans : (d) initial velocity OA & is moving with uniform retardation]

43. **A body moving with an initial velocity $5ms^{-1}$ and accelerates at $2ms^{-2}$. Its velocity after 10s is**

(a) $20ms^{-1}$ (b) $25ms^{-1}$ (c) $5ms^{-1}$ (d) $22.55ms^{-1}$

[Ans : (b) $25ms^{-1}$]

44. **In a 100m race, the winner takes 10s to reach the finishing point. The average speed of the winner is**

(a) $5ms^{-1}$ b) $20ms^{-1}$ c) $40ms^{-1}$ d) $10ms^{-1}$

[Ans : (d) $10ms^{-1}$]

45. **The area under velocity – time graph represents**

(a) velocity of the moving object
(b) displacement covered by the moving object
(c) speed of the moving object
(d) acceleration of the moving object

[Ans : (b) displacement covered by the moving object]

46. **A car is being driven at a speed of $20ms^{-1}$ when brakes are applied to bring it to rest in 5 s. The deceleration produced in this case will be**

(a) $+4ms^{-2}$ (b) $-4ms^{-2}$ (c) $-0.25ms^{-2}$ (d) $+0.25ms^{-2}$

[Ans : (b) $-4ms^{-2}$]

47. **The force responsible for drying of clothes in a washing machine is _____.**

(a) Centripetal force (b) Centrifugal force
(c) Gravitational force (d) Electro static force

[Ans : (b) Centrifugal force]

II. Fill in the blanks :

1. If a body does not change its position, then it is said to be at _____. **[Ans. rest]**

2. The back and forth motion of a swing is an _____ motion. **[Ans. Oscillatory]**

3. In uniform motion an object travels equal _____ in _____ interval of time. **[Ans. distances, equal]**

4. The actual path covered by a body is called _____. **[Ans. distance]**

5. Displacement is the _____ distance covered by a body. **[Ans. shortest]**

6. The motion of the bus is _____ motion. **[Ans. non-uniform]**

7. Rate of change of displacement is _____. **[Ans. velocity]**

8. Speed is a _____ quantity whereas velocity is a _____. **[Ans. scalar, vector]**

9. If final velocity is less than initial velocity the acceleration is _____. **[Ans. negative]**

10. If final velocity is equal to initial velocity the value of acceleration is _____. **[Ans. zero]**

11. The slope of distance time graph becomes steeper & steeper the speed _____. **[Ans. increases]**

12. A straight line parallel to x-axis in velocity time graph, it represents the object moves in _____. **[Ans. uniform velocity]**

13. From v–t graph _____ can be calculated. **[Ans. displacement]**

14. _____ measures the instantaneous speed of the automobile. **[Ans. Speedometer]**

15. Slope of velocity time graph gives _____. **[Ans. acceleration]**

16. The value of acceleration for a body at rest is _____. **[Ans. zero]**

17. At the highest point, when a body is thrown vertically upwards, the velocity is _____. **[Ans. zero]**

18. A body moves in a circular pattern the _____ of velocity does not change but _____ changes. **[Ans. magnitude, direction]**

19. When a body moves in a circular pattern _____ acceleration is directed radially towards the centre of the circle. **[Ans. centripetal]**

20. The separation of cream from milk an example for the application of _____. **[Ans. centrifugal]**

21. Consider an object is rest at position x = 20m. Then its displacement – time graph will be straight line _____ to the time axis. **[Ans : Parallel]**

III. State whether true or false. If false, correct the statement :

1. Displacement can be zero but distance never.

Ans. True.

2. Time is a vector quantity.

Ans. False.

Correct statement : Time is a **scalar** quantity.

3. Displacement magnitude can be greater than distance travelled by the object.

Ans. True.

4. If the velocity of the body decreases with time the acceleration is negative and the motion is called decelerated motion.

Ans. True.

5. Acceleration is a scalar.

Ans. False.

Correct statement : Acceleration is a **vector**.

6. The area of the velocity time graph gives displacement of the body.

Ans. True.

7. Motion & rest are relative terms.

Ans. True.

8. An object can be moving with uniform speed but variable acceleration.

Ans. True.

9. Slope of distance-time graph indicates the speed.

Ans. True.

10. It is possible to have object moving with uniform velocity but non-uniform acceleration.

Ans. True.

11. It is possible to have object moving with uniform speed but variable acceleration.

Ans. False.

Correct statement : It is possible to have object moving with uniform speed but **constant** acceleration.

12. The force experienced by a boy in the merry-go-round is a centripetal force.

Ans. False.

Correct statement : The force experienced by a boy in the merry-go-round is a **centrifugal** force.

13. The initial velocity of a freely falling object is zero as it is released from rest.

Ans. True.

IV. Assertion and reason type questions :

(a) If both assertion & reason are true and the reason is the correct explanation of the assertion.
(b) If both assertion & reason are true but the reason is not correct explanation of the assertion.
(c) If assertion is true but reason is false.
(d) If assertion & reason both are false.
(e) If assertion is false but reason is true.

1. **Assertion :** A body can have acceleration even if its velocity is zero at a given instant of time.
Reason : A body is momentarily at rest when it reverses its direction of motion.
[Ans. (a) Both assertion & reason are true and the reason is the correct explanation of the assertion]

2. **Assertion :** If the displacement of the body is zero, the distance covered by it may not be zero.
Reason : Displacement is a vector & distance is a scalar quantity.
[Ans. (a) Both assertion & reason are true and the reason is the correct explanation of the assertion]

3. **Assertion :** An object can have constant speed but variable velocity.
Reason : Speed is a scalar but velocity is vector.
[Ans. (a) Both assertion & reason are true and the reason is the correct explanation of the assertion]

4. **Assertion :** The speed of a body can be Negative.
Reason : If the body is moving in the opposite direction of positive motion, then its speed is Negative.
[Ans. (d) Assertion & reason both are false]

5. **Assertion :** The position - time graph of a uniform motion in one dimension of a body can have Negative slope
Reason : When the speed of body decreases with time then, position-time graph of the moving body has Negative slope.
[Ans. (c) Assertion is true but reason is false]

6. **Assertion** : A positive acceleration of a body can be associated with slowing down of the body.
Reason : Acceleration is a vector.
[Ans. (b) Both assertion & reason are true but the reason is not correct explanation of the assertion]

7. **Assertion** : A negative acceleration of a body can be associated with speeding up of the body.
Reason : Increase in speed of a moving body is independent of its direction of motion.
[Ans. (b) Both assertion & reason are true but the reason is not correct explanation of the assertion]

8. **Assertion** : When a body is subjected to an uniform acceleration, it is always move in a straight line.
Reason : Motion may be straight line motion or circular motion.
[Ans. (e) Assertion is false but reason is true]

9. **Assertion** : Position-time graph of a stationary object is a straight line parallel to time axis.
Reason : For a stationary object, position does not change with time.
[Ans. (a) Both assertion & reason are true and the reason is the correct explanation of the assertion]

10. **Assertion** : The slope of distance-time graph of a body moving with high speed is steeper than slope of distance -time graph of a body with low velocity.
Reason : Slope of distance-time graph = speed of the body.
[Ans. (a) Both assertion & reason are true and the reason is the correct explanation of the assertion]

V. Answer briefly :

1. What is centripetal acceleration and centripetal force?

Ans. When a body moves in a circular pattern the acceleration is directed radially towards the centre of the circle.
The force causing this acceleration is also directed towards the centre of the circle and it is called centripetal force.

2. Find the magnitude of centripetal force.

Ans. Consider an object of mass m, moving along a circular path of radius r, with a velocity v, its centripetal acceleration is given by

$$a = v^2 / r$$

Hence, the magnitude of centripetal force is given by,

$$F = \text{mass} \times \text{centripetal acceleration}$$

$$F = mv^2 / r$$

3. What is centrifugal force? Give examples.

Ans. Force acting on a body away from the centre of circular path is called centrifugal force. Thus centrifugal force is in a direction opposite to the direction of centripetal force. Its magnitude is same as that of centripetal force.

Example : Spin dryer of a washing machine, ride on a merry-go-round.

4. When an object is thrown upwards, what is true of velocity and acceleration at the highest point of motion of the object?

Ans. (i) Velocity becomes zero

(ii) Acceleration remains same as g.

5. Name the two quantities, the slope of whose graph gives (i) speed (ii) acceleration.

Ans. (i) Distance – Time

(ii) Speed – Time

6. Define Average speed.

Ans. It is the total distance travelled divided by the total time taken to cover this distance.

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{total time taken}}$$

7. What do you infer if

(i) Distance - time graph is straight line.

(ii) Velocity time graph is curved.

(iii) Displacement time is zig zag.

Ans. (i) Speed is constant.

(ii) Acceleration is not uniform.

(iii) Non uniform velocity.

8. Give the formula for each.

(i) Relation between initial, final velocity, acceleration and displacement in a uniformly accelerated straight line motion.

(ii) Relation between initial, final velocity, acceleration & time in a uniformly accelerated straight line motion.

(iii) Relation between initial velocity, acceleration, displacement and time.

Ans. (i) Relation between initial, final velocity, acceleration & displacement in a uniformly accelerated straight line motion. $v^2 = u^2 + 2as$

(ii) Relation between initial, final velocity, acceleration & time in a uniformly accelerated straight line motion. $v = u + at$

(iii) Relation between initial velocity, acceleration, displacement and time. $s = ut + \frac{1}{2}at^2$

9. What is the difference between uniform acceleration and non - uniform acceleration?

Ans.

Sl. No.	Uniform Acceleration	Non - Uniform Acceleration
1.	It is the acceleration in which the object changes its velocity with equal intervals of time.	It is the acceleration in which the object changes its velocity with unequal intervals of time.
2.	eg. The motion of a ball rolling down.	A car travels 2 km in 1st hour, 3 km in 2nd hour and 3.5 km in 3rd hour.

11. Define Acceleration.

Ans. Acceleration is the rate of change of velocity with respect to time or it is the rate of change of velocity in unit time. It is a vector quantity. The SI unit of acceleration is ms^{-2}.

VI. Paragraph Questions :

1. Define acceleration and state its SI unit for motion along a straight line, when do we consider the acceleration to be (i) positive (ii) negative? Give an example of a body in uniform acceleration.

Ans. Acceleration is the rate of change of velocity with respect to time or it is the rate of change of velocity in unit time. It is a vector quantity. The SI unit of acceleration is ms^{-2}.

$$\text{Acceleration} = \text{Change in velocity/time}$$
$$= \text{(Final velocity – initial velocity)/time}$$
$$a = \frac{v-u}{t}$$

If $v > u$, then 'a' is positive. If final velocity is greater than initial velocity, the velocity increase with time, the value of acceleration is positive.
If $v < u$, then a is negative. If final velocity is less than initial velocity
Example : The motion of a freely falling body and vertically thrown up body are the examples of uniform acceleration.
The motion of ball rolling down on an inclined plane is another example.

2. Distinguish between uniform motion and non uniform motion.

Ans.

Sl. No.	Uniform Motion	Non - Uniform Motion
1	An object is said to be in uniform motion if it covers equal distances in equal intervals of time.	If a body covers unequal distances in equal interval of time (or) equal distances in different interval of time
2	example of uniform motion 'train'	example of non - uniform motion 'bus'

3. Define uniform circular motion and give example of it. Why is it called accelerated motion?

Ans. When an object moves with constant speed along a circular path, the motion is called uniform circular motion.
When an object is moving with a constant speed along a circular path, the change in velocity is only due to the change in direction. Hence it is accelerated motion.
Example:

1. The Earth moves around the sun in the uniform circular motion.
2. The Moon moves in uniform circular motion around the Earth.

4. When a body is said to be in (i) uniform acceleration (ii) non - uniform acceleration?

Ans. (i) A body is said to be in uniform acceleration if it travels in a straight line and its velocity increases or decreases by equal amounts in equal time intervals.

(ii) A body is said to be in non-uniform acceleration if the rate of change of its velocity is not constant i.e. differs in different time intervals.

6. What remains constant in uniform circular motion? And what changes continuously in uniform circular motion?

Ans. (i) Speed remains constant in uniform circular motion.

(ii) Velocity changes continuously in uniform circular motion.

Problems

1. A bus speed decreases from 50 km/h to 40 km/h in 3s, find the acceleration of the bus.

Ans.

$$\text{Initial speed } (u) = 50 \text{ km/h} = \frac{50 \times 1000 \text{m}}{3600 \text{ sec.}} = \frac{250}{18} \text{ m/s}$$

$$\text{Final speed } (v) = 40 \text{ km/h} = \frac{40 \times 1000 \text{m}}{3600 \text{ sec}} = \frac{200}{18} \text{ m/s}$$

$$\text{Time taken } (t) = 3\text{s}$$

$$v = u + at$$

$$\therefore a = \frac{v-u}{t} = \frac{-50}{18 \times 3} = -0.925 \text{ ms}^{-2}$$

(Negative) acceleration $= -0.925 \text{ms}^{-2}$

2. A car starting from rest moves with uniform acceleration of 0.2 ms^{-2} for 3 min. Fine the (a) speed acquired (b) the distance travelled.

Ans.

Initial speed (u) = 0 m/s

Acceleration (a) = 0.2 ms^{-2}

Time taken (t) = 3 min = 3 × 60 = 180 s

Final velocity (v) = ?

Distance covered(s) = ?

$v = u + at = 0 + 0.2 \times 180 = 36$ m/s

$\boxed{v = 36 \text{ m/s}}$

$s = ut + \frac{1}{2} at^2 = 0 + \frac{1}{2} \times 0.2 \times (180)^2$

$= 0.1 \times 32400 = 3240$ m

$\boxed{s = 3240 \text{ m}}$

3. A train is travelling at a speed of 90 kmh^{-1}. Brakes are applied so as to produce a uniform acceleration of –0.5 ms^{-2}, find how far the train will go before it is brought to rest.

Ans.

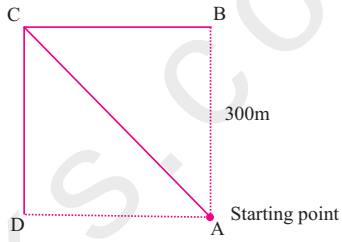
$$\text{Initial velocity of train } (u) = 90 \text{ km/h} = \frac{90{,}000 \text{m}}{3{,}600 \text{ sec}} = 25 \text{ ms}^{-1}$$

Final velocity (v) = 0 ms^{-1}

Acceleration (a) = – 0.5 ms^{-2}

$$v^2 = u^2 + 2as$$
$$\Rightarrow s = (v^2 - u^2) / 2a = (0^2 - 25^2) / -(2 \times 0.5)$$
$$s = \frac{-625}{-1} = 625 \text{ m}$$
$$\boxed{s = 625 \text{ m}}$$

4. In a long distance race the athletes were expected to take four rounds of the track such that the line of finish was same as the line of start. Suppose the length of the track was 300m,



(i) What is the total distance to be covered by the athletes?

(ii) What is the total displacement of the athletes when they touch the finish line?

(iii) Is the motion of the athletes uniform or non-uniform?

(iv) Is the displacement & distance moved by athlete at the end of the race equal?

Ans.

(i) Total distance covered = $4 \times 300 = 1200$ m

(ii) Displacement = 0 [final position – initial position]

(iii) Non - uniform.

∵ the direction of motion is changing while running on the track.

(iv) Both are not equal.

5. Ram swims in a 80m long swimming pool. He covers 160m in 1 min by swimming from one end to the other and back along the same straight pattern. Find the average speed and average velocity.

Ans.

Total distance = 160m

Total displacement = 0

Time taken (t) = 1 min = 60s

$$\text{Average speed } (s_{average}) = \frac{\text{total distance}}{\text{total time taken}}$$
$$s_{average} = \frac{160}{60} = 2.66 \text{ m/s}$$
$$\text{Average velocity } (v_{average}) = \frac{\text{total displacement}}{\text{total time taken}} = \frac{0}{60} = \mathbf{0 \text{ m/s.}}$$

6. A bus from Chennai travels to Trichy passes 100 km, 160 km at 10.15 am, 11.15 am respectively. Find the average speed of the bus during 10.15 - 11.15 am.

Ans. The distance covered between 10.15am & 11.15 am = 160 – 100

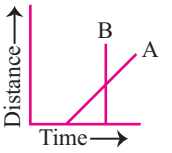
= 60 km

The time interval = 1 h

$$\text{Average speed} = \frac{60}{1}$$

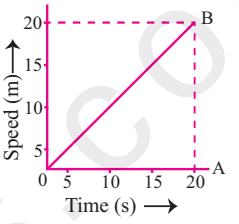
= **60 km/h**

7. In a distance - time graph of two objects A & B, which object is moving with greater speed when both are moving?



Ans. Object B makes a longer angle with the time - axis. Its slope is greater than the slope of the object A. Thus the speed of B is greater than that of A.

8. Find the distance covered by a particle during the time interval t = 0 to t = 20s for which the speed - time graph is shown in figure.



Ans. Distance covered in the time interval 0 to 20s is equal to the area of the triangle OAB.

Area of Δ OAB. ½ × base × height

½ × 20 × 20 = **200 ms^{-1}**

9. A car moves 30 km in 30 min and the next 30 km in 40 min. Calculate the average speed for the entire journey.

Ans. Total time taken = 30 + 40 = 70 min. = $\frac{70}{60}$ hour

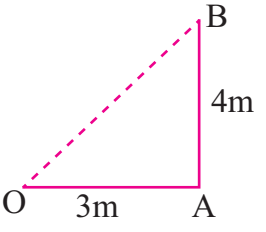
Total distance = 30 + 30 = 60 km

Average speed, $v_{average}$ = $\frac{\text{Total distance}}{\text{Time taken}} = \frac{60}{\frac{70}{60}} = \frac{3600}{70}$ = **51.4 km/h**

10. A boy travels a distance of 3m due east and then 4m due north.

(a) How much is the total distance covered?

(b) What is the magnitude of the displacement?



Ans. (a) Total distance covered = 3 + 4 = 7m

(b) Net displacement : OB^2 = $OA^2 + AB^2$

$= 3^2 + 4^2$

$OB^2 = 25m^2$

$\therefore$ OB = 5m

Net displacement = **5m**

11. During an experiment, a signal from a spaceship reached the ground station in five seconds. What was the distance of the spaceship from the ground station? The signal travels at the speed of light that is 3×10^8 ms^{-1}.

Ans. Time taken = 5 seconds.

Speed of signal u = 3×10^8 m/s

Distance = ?

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

$\therefore$ Distance = Speed × Time

Distance = $3 \times 10^8 \times 5$ = **15×10^8 m.**

12. A train travelling at a speed of 90kmph. Brakes are applied so as to produce a uniform acceleration of –0.5 ms^{-2}. Find how far the train will go before it is brought to rest?

Ans. Here we have

Initial velocity, u = 90 km/h

$= \frac{90\times1000m}{60\times60s} = 25m/s$

Final velocity, v = 0

Acceleration, a = –0.5 m/s^2

Thus, distance travelled = ?

We know that, $v^2 = u^2 + 2as$

$\Rightarrow 0 = 25\ m/s^2 + 2 \times -0.5\ m/s^2 \times s$

$= 625\ m^2/s^2 - 1m/s^2 \times s$

$\Rightarrow 1\ ms^{-2}s = 625\ m^2s^{-2}$

$s = \frac{625m^2s^{-2}}{1ms^{-2}} =$ **625 m**

∴ Train will go 625m before it is brought to rest

13. The adjacent diagram shows the velocity time graph of a body.

a) During what time interval is the motion of the body accelerated?

Ans. At 0 to 4 second

b) Find the acceleration in the time interval mentioned in part '*a*'.

Ans. $a = \frac{v-u}{t} = \frac{30-0}{4} =$ **7.5 m/s^2**

c) What is the distance travelled by the body in the time interval mentioned in part 'a'?

Ans. Distance travelled = Area under the graph

= Area of the triangle = ½ *bh*

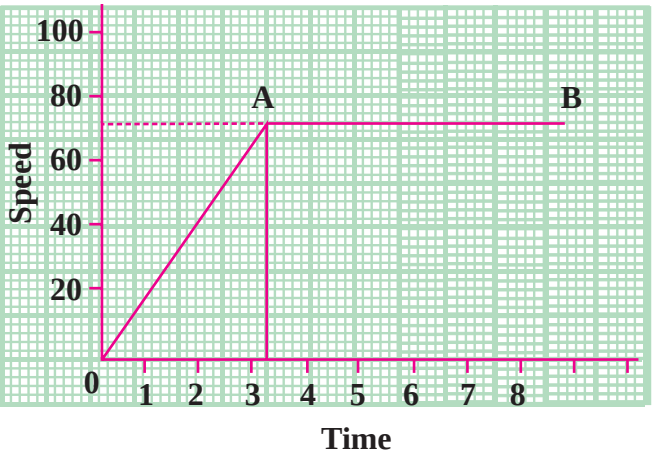
= ½ × 4 × 30 = **60m**

14. The following graph shows the motion of a car. What do you infer from the graph along OA and AB? What is the speed of the car along AB and what time it reached this speed.

a) What do you infer from the graph along OA and AB

Ans. Graph along OA : The car travels with uniform acceleration and uniform motion.

Graph along AB : The car travels with constant speed and unaccelerated motion.



b) What is the speed of the car along AB?

Ans. Along AB : The speed of the car is constant.

From the graph, it seems the speed along AB is 72 km/hr.

c) What time it reached this speed

Ans. It reaches this speed after 3.2 hours, that is, 3 hours, 12 minutes.

15. From the following table, check the shape of the graph.

Time (s)	0	2	4	6	8	10	12
Velocity (ms^{-1})	0	20	40	40	40	20	0

Ans.