Physical Quantities and Measurement

- **Synposis**
- The observation of a phenomenon is made possible by using the five senses: sight, smell, touch, hearing and taste.
- Our senses are not always reliable. They are subjective.
- Sometimes it is necessary to make an exact measurement.
- Physics is a science of measurement.
- We use instruments to get an exact measurement.
- Four basic measurements in our daily life are: measurement of length, measurement of mass, measurement of time, and measurement of temperature.
- Measurement is basically a process of comparison of the given quantity with a standard unit.
- For measuring a quantity we need a unit, and then we find the number of times that unit is contained in that quantity.
- The unit selected for measurement should be of a convenient size and it must not change ‘with place or time.
- The distance between two fixed points is called length.
- The S.I. unit of length is metre (m). Its multiple is kilometre (km), where 1 km = 1000 m. Its sub multiples are centimetre (cm) and millimetre (mm), where 1 cm = 10^{-2} m and 1 mm = 10^{-3} m.
- The FPS unit of length is foot (ft) and its sub multiple is inch where 1 ft = 12 inch and 1 ft = 30.48 cm.
- The most common instruments used to measure length are the metre ruler and the measuring tape which are marked in cm and mm.
- To measure a length accurately with a metre ruler, the scale should be placed with its markings close to the object and parallel to its r length. The eye is kept in front of and in line with the reading to be taken.
- The quantity of matter contained in a body is called its mass.
- The S.I. unit of mass is kilogram (kg). Its multiples are quintal and metric tonne. 1 quintal = 100 kg and 1 metric tonne =10 quintal = 1000 kg. Its sub multiples are gram (g) and milligram (mg) where 1 g = 10 kg and lmg = 10^{-6} kg.
- The FPS unit of mass is pound (lb) where 1 lb = 453.59 g.
- Mass of a body is measured by using a beam balance or an electronic balance.
- The interval between two instances or events is called time.
- The S.l. unit of time is second (s), 1 s 1 / 86400 of a mean solar day. The C.G.S. and F.P.S. unit of time is also second (s).
- The multiple unit of time are minute (mm), hour (h), day and year where 1 min = 60 s, 1 h = 3600 s, 1 day = 86400 s and 1 year = 3.15×10^{7} s.
- The time at any instant is recorded by a pendulum clock or watch and the time interval of an event is measured by using a stop watch or a stop clock.
- The temperature is the measure of degree of hotness or coldness of a body.
- The S.I. unit of temperature is kelvin(K), but the common unit of temperature is degree Celsius (°C) and degree fahrenheit (°F).
- Doctors use a clinical thermometer to measure the patient’s body temperature.
- The normal temperature of a human body is 37°C or 98.6°E
- The total surface occupied by an object is called its area. Area is expressed as the product of measured length of two sides.

- The S.I. unit of area is square metre (m^2).
- One square metre is the area of a square of each side one metre.
- The bigger (or multiple) units of area are dam^2, hectare and square kilometre (km^2), where 1 dam^2=100 m^2,1 hectare= 10^4 m^2 and 1 km^2 = 10^6 m_2
- The smaller (or sub multiple) units of area are cm^2 and mm^2 where 1cm^2 = 10^{-4} m^2 and 1 mm^2 = 10^{-6} m^2

Test yourself

A. Objective Questions

1. Write true or false for each statement

(a) S.I. unit of temperature is fahrenheit.
Answer. False

(b) Every measurement involves two things – a number and a unit
Answer. True

(c) Mass is the measure of quantity of matter.
Answer. True

(d) The S.I. unit of time is hour.
Answer. False

(e) The area can be expressed as the product of length of two sides.
Answer. Tme

2. Fill in the blanks

(a) The S.I. unit of length is **metre** of time is **second** of mass is **kilogram.**
(b) °C is the unit of **temperature.**
(c) 1 metric tonne = **1000 kg**
(d) The zero mark in Celsius thermometer is the melting point of **ice**
(e) The thermometer used to measure the human body temperature is called the **clinical** thermometer.
(f) The normal temperature of human body is **37** °C or **98.6** °F.
(g) The **mass** of an object is measured with the help of a beam balance.

3. Match the following columns

Column A	Column B
(a) Length of a housing plot	**(i) Clock**
(b) Breadth of a book	**(ii) Beam balance**
(c) Mass of an apple	**(iii) Thermometer**
(d) Period of time for study	**(iv) Measuring tape**
(e) Temperature of a body	**(v) Graph paper**
(f) Surface area of a leaf	**(vi) Metre ruler**

Column A	Column B
(a) Length of a housing plot	(iv) Measuring tape
(b) Breadth of a book	(vi) Metre ruler
(c) Mass of an apple	(ii) Beam balance
(d) Period of time for study	(i) Clock
(e) Temperature of a body	(iii) Thermometer
(f) Surface area of a leaf	(v) Graph paper

4. Select the correct alternative

(a) The symbol of degree Celsius is

1. **°C**
2. °F
3. K
4. °K

(b) lO mm is equal to

1. **1cm**
2. 1m
3. 10dm
4. 10cm

(c) The amount of surface occupied by an object is called its:

1. volume
2. **area**
3. mass
4. length

(d) A metre ruler is graduated in:

1. m
2. cm
3. **mm**
4. km

(e) A thermometer is graduated in:

1. kelvin
2. **°C**
3. g
4. cm

B. Short/Long Answer Questions

Question 1.
What is measurement? How is a measurement expressed?
Answer:
Measurement is a comparison of an unknown quantity with a known fixed quantity of the same kind.
The value obtained on measuring a quantity is called its magnitude. The magnitude of a quantity is expressed as numbers in its unit.

Question 2.
State two characteristics of a unit.
Answer:
Two characteristics of a unit are

1. It should be of convenient size.
2. It must be universally accepted, i. e. its value must remain same at all places and at all times.

Question 3.
Name four basic measurements in our daily life.
Answer:
In our daily life we measure the following four basic physical quantities.

1. Length
2. Mass
3. lime
4. Temperature

Question 4.
What are the S.I. units of

1. mass
2. length
3. time and
4. temperature. Write their names and symbols.

Answer:
S.I. units are as follows

	Quantity	S.I. unit	Symbol of S.I. unit
(i)	Length	metre	m
(ii)	Mass	kilogram	kg
(iii)	Time	second	s.
(iv)	Temperature	kelvin	k

Question 5.
Define one metre, the S.I. unit of length. State its one multiple and one sub multiple.
Answer:

One metre is defined as the distance travelled by light in air in $\frac{1}{299,792,458}$ of a second
Multiple of metre = Kilometre
Submultiple of metre = Centimetre

Question 6.
Convert the following quantities as indicated
(a) 12 inch = ft
(b) 1 ft = cm
(c) 20 cm = m
(d) 4.2 m = cm
(e) 0.2 km = m
(f) 0.2 cm = mm
(g) 1 yard = m
Answer:
(a) l2 inch 1 ft
(b) 1ft = 30.48cm

(c) lOO cm 1m

$\because$ $1\text{ cm} = \frac{1}{100}\text{ m}$

$\therefore$ $20\text{ cm} = \frac{1}{100} \times 20\text{ m} = 0.2\text{ m}$

$\therefore$ $20\text{ cm} = \mathbf{0.2}\text{ m}$

(d) $1\text{ m} = 100\text{ cm}$

$\therefore$ $4.2\text{ m} = 100 \times 4.2\text{ cm}$

$= 100 \times \frac{42}{10}\text{ cm} = 420\text{ m}$

$\therefore$ $4.2\text{ m} = \mathbf{420}\text{ cm}$

(e) $1\text{ km} = 1000\text{ m}$

$\therefore$ $0.2\text{ km} = 1000 \times 0.2\text{ m}$

$= 1000 \times \frac{2}{10}\text{ m} = 200\text{ m}$

$\therefore$ $0.2\text{ km} = \mathbf{200}\text{ m}$

(f) $1\text{ cm} = 10\text{ mm}$

$\therefore$ $0.2\text{ cm} = 10 \times 0.2\text{ mm}$

$= 10 \times \frac{2}{10}\text{ mm} = 2\text{ mm}$

$\therefore$ $0.2\text{ cm} = \mathbf{2}\text{ mm}$

(g) $1\text{ yard} = \mathbf{0.91}\text{ m}$

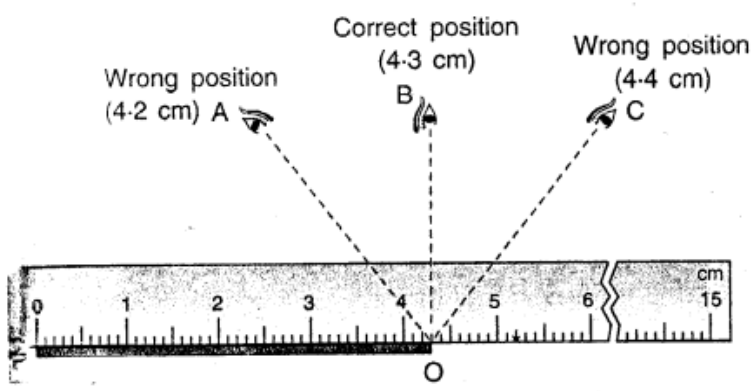
Question 7.

(a) Describe in steps how would you measure the length of a pencil using a metre rule. Draw a diagram if necessary.

Answer:

To measure the length of a pencil using a metre rule, place metre rule with its marking close to the object. Let PQ be a pencil.

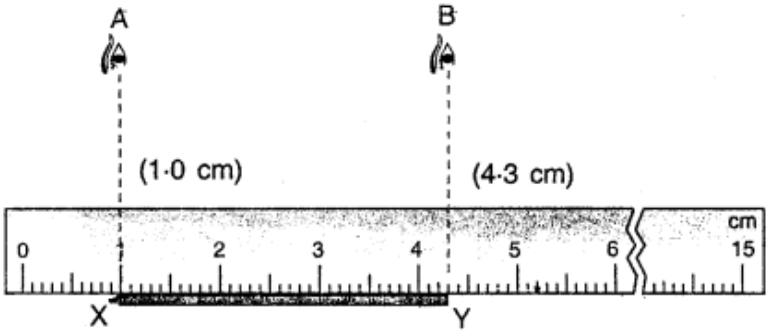
The end P of the pencil coincides with the zero mark on the ruler. The end Q of the pencil is read by keeping the eye at the position ‘B’ vertically above the end Q. So the length of pencil is 4.3 cm.



Measuring the length of a a rod PQ with a metre ruler

(b) Explain with an example how you will use the metre ruler in part (a) if the ends of ruler are broken.

Ans. The ends of the ruler get damaged with use and its zero mark may not be visible. To measure the length of an object with such a ruler, the object is placed close to a specific markings on the ruler and positions of both ends of the object are read on the ruler.



The difference of the two readings gives the length of the object. In fig. the reading on ruler at the end X is 1.0 cm and at the end Y is 4.3 cm. So the length of the rod XY is 4.3 — 1.0 = 3.3 cm.

Question 8.

Name the device which you will use to measure the perimeter of your play ground. Describe in steps how you will use it.

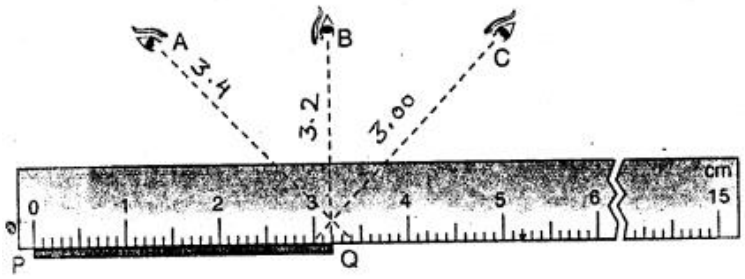
Answer:

We will use a measuring tape to measure the perimeter of our playground.

To measure the length of playground the tape is spread along the length of the curved area.

Question 9.

The diagram below shows a stick placed along a metre RULER. The length of the stick is measured keeping the eye at positions A, B and C.



Answer:

(a) Write the length if stick PQ as observed, for each position of the eye. Are they all same?

Ans. Length of stick PQ from

Position A =3.4 cm

Position B = 3.2cm

Position C = 3.00 cm

No they are not same.

(b) Which is the correct position of the eye? Write the correct length of the stick.

Ans. 'B' is the correct position of the eye. Correct length of the stick PQ = 3.2cm

Question 10.

Define mass. State its (1) S.I. (2) C.GS and (3) EP.S. units. How are they related ?

Answer:

The mass of a body is the quantity of matter contained in it. The S.I. unit of mass is kilogram. In short form, it is written as kg.

In C.GS. system, the unit of mass is gram, (symbol g).

In F.P.S. system, the unit of mass is pound (symbol lb)

Question 11.

Convert the following quantities as indicated:

(a) 2500 kg = ……. metric tonne.

(b) 150 kg = quintal

(e) 10 lb = ……. kg

(d) 250 g = … .kg

(e) 0.01 kg = ……. g

(f) 5 mg = ……. kg

Answer:

(a) 2500 kg = **2.5** metric tonne.

1000 kg = 1 metric tonne

$1 \text{ kg} = \frac{1}{1000}$ metric tonne

$\therefore$ $2500 \text{ kg} = \frac{1}{1000} \times 2500$ metric tonne

$\therefore$ 2500 kg = 2.5 metric tonne

(b) 150 kg = **1.5** quintal

100 kg = 1 quintal

$1 \text{ kg} = \frac{1}{100}$ quintal

$150 \text{ kg} = \frac{1}{100} \times 150$ quintal

$= 1.5$ quintal

$\therefore$ 150 kg = 1.5 quintal

(c) 10 lb = **4.5359** kg

1 lb = 453.59 g

$= 453.59 \times \frac{1}{1000}$ kg $\quad [\because 1 \text{ kg} = 1000 \text{ g}]$

= 0.45359 kg

$\therefore$ 10 lb = 0.45359 × 10 kg

= 4.5359 kg

$\therefore$ 10 lb = 4.5359 kg

(d) 2500 g = **2.5** kg

$1000\ g = 1\ kg$

$1\ g = \frac{1}{1000}\ kg$

$\therefore\ 2500\ g = \frac{1}{1000} \times 2500\ kg = 2.5\ kg$

$\therefore\ 2500\ g = 2.5\ kg$

(e) $0.01\ kg = \mathbf{10}\ g$

$1\ kg = 1000\ g$

$\therefore\ 0.01\ kg = 1000 \times 0.01\ g$

$= 1000 \times \frac{1}{100}\ g = 10\ g$

$\therefore\ 0.01\ kg = 10\ g$

(f) $5\ mg = \mathbf{5 \times 10^{-6}}\ kg$

$5\ mg = \frac{5}{1000}\ g \text{ or } 5 \times 10^{-3}\ g$

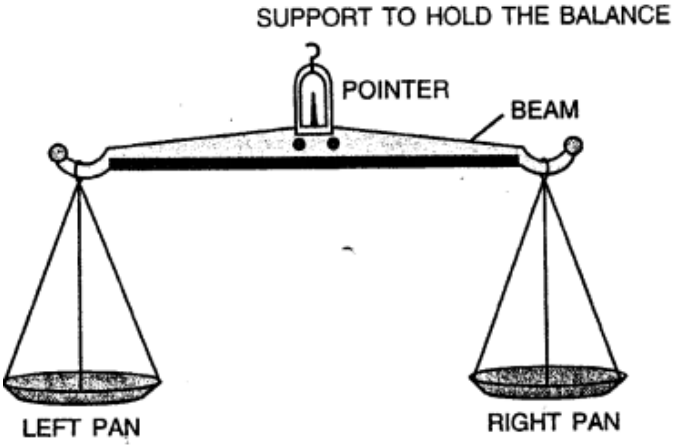
$\frac{5}{1000}\ g \text{ or } 5 \times 10^{-3}\ g = \frac{5}{1000 \times 1000} \text{ or } 5 \times 10^{-6}\ kg$

Question 12.

Name the instrument which is commonly used to measure the mass of a body. State how is it used ?

Answer:

Instrument commonly used to measure the mass of a body, is the beam balance.



When we hold up the balance, we observe that when there is nothing on either pan, the beam is horizontal. The body whose mass is to be measured is placed on the left pan. The standard weight are put on the right pan. They are so adjusted that the beam is again horizontal on holding the balance up. The total of the standard weights gives the mass of the given body.

Question 13.
Define one kilogram, the S.I. unit of mass. How is it related to (i) quintal (ii) metric tonne and (iii) gram.
Answer:
The mass of 1 litre of water at 4 °C is taken as 1 kilogram
1 quintal = 100 kg
1 metric ton = 10 quintal = 1000 kg

Question 14.
Name and define the S.I. unit of time. How is it related to (i) minute (ii) hour, (iii) day and (iv) year ?
Answer:
The S.I. unit of time is second. In short form we write it as ‘ S ’.
One second is the time interval between the two consecutive ticks that you hear from pendulum wall clock.
1 min = 60 s
1 h = 60 min. = 3600 s.
1 day = 24 h = 86400 s.
1 year = 365 days = 3.15×10^7 s.

Question 15.
Name two devices used to measure the short time interval of an event.
Answer:
Two devices used to measure the time interval of an event are

1. StopWatch
2. Stop Clock

Question 16.
Express in second

1. 3 minute 15 second and
2. 5 hour 2 minute 5 second.

Answer:

1. 3 minute = 15 second
   1 minute = 60 second
   3 minutes 15 second = 60 × 3 + 15
   = 180 + 15
   = 195 seconds
2. 1 minute =60 second
   2 minutes =2 × 600 = 120 second …(1)
   1 hour 3600 second

5 hour 3600 × 5 = 18000second …(2)
5 hour 2 minutes and 5 second
= 18000 + 120 + 5 = 18125 seconds

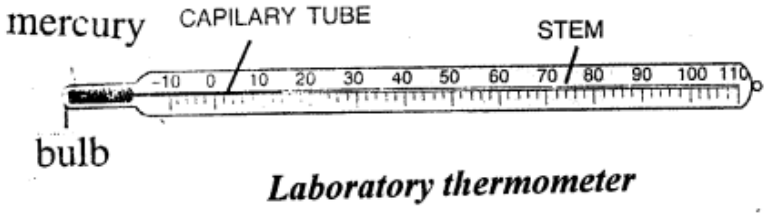
Question 17.
What does the temperature measure ?
Answer:
Temperature measures the degree of coldness and hotness of a body.

Question 18.
Name the

1. S.I. unit and
2. one common unit of temperature. Write their symbols also.

Answer:
The S.I. unit of temperature is kelvin (symbol K).
Common unit of temperature is degree centigrade (symbol °C)

Question 19.
Name the instrument used for measuring of the temperature of a person. Draw its labelled neat diagram.
Answer:
The temperature is measured with a thermometer.



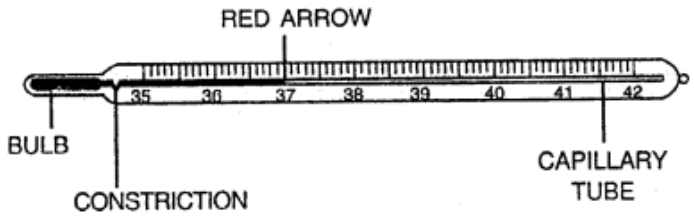
Laboratory thermometer

Question 20.
Write the temperature of (i) melting ice (ii) boiling water.
Answer:
The temperature of

1. melting ice = 0 °C
2. boiling water = 100 °C

Question 21.
What is a clinical thermometer? State its special feature. Draw a labelled neat diagram of a clinical thermometer showing the range of temperature marked on it.
Answer:
Doctors use a special thermometer called the clinical thermometer for measuring the

temperature of the patient's body. This thermometer has the markings from 35°C to 42°C. It has a slight bend or kink in the stem just above the bulb. This kink is called the constriction. This constriction prevents the mercury from falling back all by itself. The temperature of a healthy person is 37°C. This temperature is marked by a red arrow.



linical thermometer

Question 22.
What is the normal temperature of the human body? How is it indicated in a clinical thermometer?
Answer:
Normal temperature of a human body is 37°C or 98.6 °F.
To measure the temperature of a patient's body, its bulb is kept either below the tongue or under the arm's pit of the patient for about a minute. Then the thermometer is taken out and its reading is noted. When the temperature of patient's body is above 37°C, he is said to suffer with fever.

Question 23.
Can a clinical thermometer be used to measure the temperature of the boiling water ? Give reason for your answer.
Answer:
No, a clinical thermometer cannot be used to measure the temperature of boiling water.
,
The reasons are

1. It has a very small range.
2. It can break on cooling and on excess heating.

Question 24.
Explain the term 'area of a surface'.
Answer:
The total surface occupied by an object is called its area or surface area.

Question 25.
Name the S.I. unit of area and define it.
Answer:
The S.I. unit of area is square metre or meter2 which in short form is written as m2.

Question 26.
How are the units

1. square yard
2. hectare
3. km^2
4. cm^2
5. mm^2 related to the S.I. unit of area ?

Answer:

(i) square yard : One square yard is the area of a square of each side 0.836 metre

1 square yard = 1 yard × 1 yard

= 0.9144 m × 0.9144 m

= 0.836 m^2 (or 0.84 m^2 nearly)

(ii) hectare : One hectare is the area of a square of each side 100 metre. Thus,

1 hectare = 100 metre × 100 metre = 10000 $metre^2$

(or 10^4 m^2)

(iii) km^2 : One square kilometre is the area of a square of each side 1 kilometre. Thus,

1 km^2 = 1 km × 1 km = 1000 m × 1000 m = 10^6 m^2

(iv) cm^2 : $1\ cm^2 = \left(\frac{1}{100}\ m\right) \times \left(\frac{1}{100}\ m\right) = \frac{1}{10000}\ m^2$

$= 10^{-4}\ m^2$

(v) mm^2 : 1 mm^2 = 10^{-6} m^2

Question 27.
Explain how you will measure the area of (i) a square (b) a leaf?

Answer:
The area of a square can be calculated by using the following formula –
1. Area of square of side l
= side x side
= l × l = L^2 .
The area of a leaf is obtained by using a graph paper. A graph paper has small squares of each side 1 mm. The area of each big square is 1 cm^2.
Procedure: Place the leaf on graph paper. Draw its outline on the paper and remove it. Now count the number of complete squares. To this add the number of incomplete squares which are half or more than half. Ignore the squares which are less than half. Thus,

Approximate area = (No. of complete squares + no. of half or more than half of incomplete squares) × area of one square.

ADDITIONAL QUESTIONS

CHECK YOUR PROGRESS 1

A. State if the following statements are true or false. Correct the statement if it is false.

1. In ancient times, a cubit was used to measure the mass of an object.
Answer. False.
In ancient times, a cubit was used to measure the length of an object.

2. There are seven base units in the SI system.
Answer. True

3. Second is considered as the fundamental unit of time in both CGS and MKS systems.
Answer. True

4. Centi mean 'a hundredth part'.
Answer. True

5. The symbol used for a unit is always written in capital letters.
Answer. False.
The symbol used for a unit is normally written in small letters.

B. Answer the following in short.

Question 1.
What do you understand by the term 'measurement'?
Answer:
Determining the exact value of an unknown quantity by comparing it with a known fixed quantity is called as measurement.

Question 2.
What are derived physical quantities? Give any two examples of derived physical quantities.
Answer:
Physical quantities that are derived from one or more fundamental physical quantities are called derived physical quantities. Examples: area, volume, speed, density, etc.

Question 3.
What are the characteristics of a standard unit?
Answer:

1. It should be accepted universally.
2. It should be accurate.
3. It should be neither too small nor too big and easy to use.

Question 4.
Mention any two advantages of the metric system over traditional units.
Answer:

1. The metric units are accurate whereas the traditional units were not uniform.
2. The metric system is accepted globally whereas the traditional units had different values at different places.

Question 5.
Which institution in the world maintain the guidelines for using the SI units correctly ?
Answer:
General Conference of Weights and Measures.

C. Answer the following in detail.

Question 1.
What are fundamental physical quantities? Name any three fundamental physical quantities.
Answer:
Basic physical quantities that do not depend upon other quantities are called fundamental physical quantities. There are seven fundamental quantities – length, mass, temperature, time, electric current, luminous intensity and amount of substance.

Question 2.
Explain by giving two examples why the measurement of a physical quantity is expressed as a combination of a numeral and a unit.
Answer:
To measure a physical quantity, we need to compare it with a known fixed physical quantity of the same kind, i.e., a unit. Hence, the measurement of a physical quantity is always written as a combination of a numeral along with the unit. The numeral specifies the number of times the unit is repeated. **Example:**

1. Using a centimetre scale, the length of pencil box is found to be 20 centimeters (cm). 20 cm simply means that the length is 20 times a centimetre. (The centimetre forms the unit of length in a centimetre scale.) Here, the number 20 is the numeral (magnitude) and cm is the unit.

2. Using a weighing (kilogram) scale, the weight of the box is found to be 2 kilograms (kg) 2 kg simply means that the mass of the box is 2 times a kilogram. (The kilogram forms the unit of mass in a kilogram scale). Here, the number 2 is the numeral (magnitude) and kg is the unit.

Question 3.
Explain in detail why there was a need to standardize units.
Answer:
The traditional units were not uniform as the length of a cubit, foot and handspan varied from person to person according to their body size. Similarly, there was no certainty that all grains were exactly the same weight. So these units could not be used for scientific measurements where accuracy was a prime concern. The development of a large number of systems of measurement also made it very difficult to conduct trade and commerce between different socities. Therefore, people felt the need to have standard units which could be used for accurate measurement and were accepted universally.

Question 4.
Why are multiples and submultiples of SI units required?
Answer:
Sometimes, the size of the SI unit is either too small or too big to measure a certain quantity. For example, a metre is too small a unit to measure the distance between two cities and too big a unit to measure the thickness of a wire. Hence, multiples and submultiples of units are required. Multiples are factors used to create larger forms whereas submultiples are factors used to create smaller forms of the SI units. For example, a centimetre is a submultiple and kilometre is a multiple of a metre.

Question 5.
State some common rules to write SI units correctly.
Answer:

Guidlines for capitalization

	Guidlines	Examples
Unit Names	If a unit is derived from the name of a person, its name is always written in small letters. A unit not named after persons is written in small letters.	newton (not Newton), joule (not Joule) metre (not Metre) second (not Second)
Unit Symbols	The symbol used for a unit is normally written in small letters. If the symbol of unit is derived from the name of a person, it is written in capital letters. If a unit is represented by more than one letters, the first letter of the symbol is capitalized.	metre : m (not M), second : s (not S) newton : N (not n), amphere : A (not a) pascal : Pa, hertz : Hz
Prefix Names	Prefix names are written in small letters, unless they occur at the beginning of a sentence. No space or hyphen is used between the prefix and the unit name. So a prefix name and a unit name are taken together as a single word.	milligram (not Milligram or milli-gram of milli-gram), centimetre (not Centimetre or centi metre or (centi-metre)
Prefix Symbols	Prefix symbols are attached to unit symbols without any space between them. Prefix symbols up to the kilo level are written in small letters but the ones with larger values are written in capital letters.	mg (milligram) MW (megawatt)

Guidelines for Plurals

Guidelines	Examples
The plural form is used only when the unit is written in full. Symbols of units are never written in plural. So, 's' is not added to the symbol of a unit.	10 metres : 10 m (not 10 ms) 10 seconds : 10 s (not 10 ss)

Guidelines for punctuation

Guidelines	Examples
A full stop is never put at the end of a unit symbol unless it occurs at the end of a sentence.	"It is 50 cm long."but not "It is 50 cm. long."

Check Your progress

A. Tick the most appropriate answer.

1. The SI unit of mass is

1. gram
2. milligram
3. **kilogram**
4. pound

2. To measure the volume of an irregular shaped body, we use a

1. graph paper
2. beam balance
3. **measuring cylinder**
4. ruler

3. Which of the following weighing devices has a very high accuracy and sensitivity ?

1. Beam balance
2. Grocer's balance
3. **Physical balance**
4. Spring balance.

B. State if the following statements are true or false. Correct the statement if it is false.

1. Area of an object is a fundamental physical quantity.
Answer. False.
Area of an object is a derived physical quantity.

2. The error in reading a scale due to the wrong positioning of the eye is called human error.
Answer. False.
The error in reading a scale due to the wrong positioning of the eye is called parallax error.

3. The region enclosed within the boundaries of a two-dimensional figure is called its area.
Answer. True.

4. The length of an irregular object can be found with the help of a graph paper.
Answer. False.
The area of an irregular object can be found with the help of a graph paper.

C. Match the following.

	Column A	Column B
1.	Length	a. kilogram
2.	Mass	b. cubic metre
3.	Area	c. metre
4.	Volume	d. square metre

Ans.	Column A	Column B
1.	Length	c. metre
2.	Mass	a. kilogram
3.	Area	d. square metre
4.	Volume	b. cubic metre

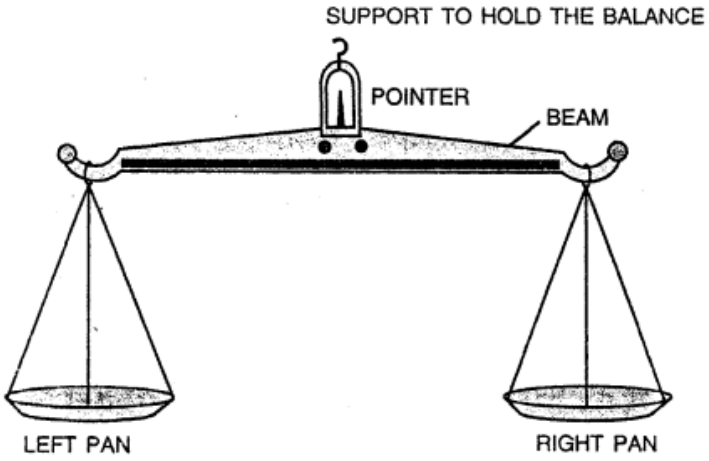
D. Answer the following in short.

Question 1.
Which unit will you use to find the length of your notebook and why ?
Answer:
Centimetre. Because a notebook has a length for which metre would be too large a unit to measure and millimetre would be too small.

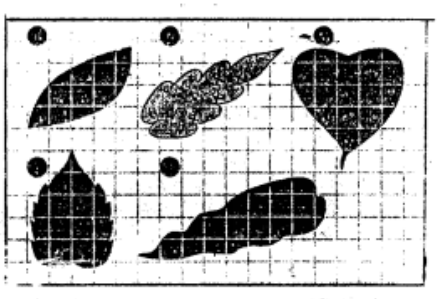
Question 2.
What do you understand by the 4erm ‘mass’ ? Name any one instrument used for weighing.
Answer:
The amount of matter present in an object is called its mass. Instruments used to

measure mass are beam balance, spring balance, physical balance, electronic weighing machines, etc.

Question 3.
Explain the working of a beam balance.
Answer:
A beam balance is the simplest instrument to measure mass (weight). In a beam balance, the mass of an object is measured by comparing it with standard masses called standard weights. A simple beam balance consists of a straight beam of a metal (generally iron), supported at its centre with the help of an iron loop. A pointer is fixed at the centre of the iron loop. Two identical pans are suspended at equal distances from the centre, at the two ends of the beam.
Working : The object whose mass has to be measured is placed on one of the pans (generally the right pan). Standard weights are placed on the other pan until the metallic beam becomes hori7ontal and the pointer becomes vertical. The sum total of all weights used gives the mass of the object.



E. Find the area of these leaves, where 1 square on the graph paper represents 1 cm².



1. **Ans.** The area of leaf 1

$= 1 \times$ (Number of complete squares) cm^2

$+ \frac{1}{2} \times$ (Number of half or more than half squares) cm^2

$= 1 \times 3\ cm^2 + \frac{1}{2} \times 5\ cm^2$

$= 3\ cm^2 + 2.5\ cm^2$

$= 5.5\ cm^2$

2. **Ans.** The area of leaf 2

$= 1 \times$ (Number of complete squares) $cm^2 + \frac{1}{2} \times$ (Number of half or more than half squares) cm^2

$= 1 \times 3\ cm^2 + \frac{1}{2} \times 5\ cm^2$

$= 3\ cm^2 + 2.5\ cm^2$

$= 5.5\ cm^2$

3. **Ans.** The area of leaf 3

$= 1 \times$ (Number of complete squares) cm^2

$+ \frac{1}{2} \times$ (Number of half or more than half squares) cm^2

$= 1 \times 7\ cm^2 + \frac{1}{2} \times 9\ cm^2$

$= 7\ cm^2 + 4.5\ cm^2$

$= 11.5\ cm^2$

4. **Ans.** The area of leaf 4

$= 1 \times$ (Number of complete squares) cm^2

$+ \frac{1}{2} \times$ (Number of half or more than half squares) cm^2

$= 1 \times 6\ cm^2 + \frac{1}{2} \times 8\ cm^2$

$= 6\ cm^2 + 4\ cm^2$

$= 10\ cm^2$

5. **Ans.** The area of leaf 5

$= 1 \times$ (Number of complete squares) cm^2

$+ \frac{1}{2} \times$ (Number of half or more than half squares) cm^2

$= 1 \times 6\ cm^2 + \frac{1}{2} \times 9\ cm^2$

$= 6\ cm^2 + 4.5\ cm^2$

$= 10.5\ cm^2$

Measurement of Time And Temperature ; Approximations

Exercises

A. Tick the most appropriate answer.

1. Which of the foliowing is a fundamental physical quantity?
Speed
Area
Volume
Time

2. The system of measurement based on centimetre-gram- second is known as
SI system
FPS system
MKS system
CGS system

3. The region enclosed within the boundaries of a closed figure is known as its length
area
volume
temperature

4. Which of the following devices is used to measure mass?
Ruler
Measuring cylinder
Beam balance
Stopwatch

5. Which of the following is not a common unit for measuring time ?
Hour
Mean solar day
Year
Sundial

6. A train departs from Delhi railway station at 21:50 hours every day. The time shown in you analogue watch at the departure will be
2:50 a.m
9:50 p.m.
9:50 a.m.
11:50 p.m.

7. The total number of divisions in the Celsius scale is
90
100
180
360

8. The maximum and minium thermometer is commonly used by a
doctor
student
meteorologist
goldsmith

B. Fill in the blanks.

1. There are **seven** fundamental physical quantities.
2. In the **CGS** system, length is measured in centimeters.
3. 1 kilometre is equal to **1000** metres.
4. The amount of matter contained in a body is known as its **mass.**
5. The first two digits in a 24 hour time fomiat represent the number of **hours.**
6. If the departure time of a train on a railway ticket is printed as 20:35, then it will depart at **8.35 p.m.**
7. The lower fixed point in a laboratory thermometer is the same as that of —**10°C.**
8. The temperature at which water freezes is known as **ice point.**

C. State if the following statements are true or false. Correct the statement if it is false.

1. The average of a group of observations is calculated by adding all the observations and dividing the sum by the number of observations.
Answer. True

2. A laboratory thermometer has a kink in its capillary tube.
Answer. False.
A clinical thermometer has a kink in its capillary tube.

3. Water is the most commonly used thermometric substance.
Answer. False.
Mercury is the most commonly used thermometric substance.

4. Mercury does not stick to the surface of glass.
Answer. True

5. 1 m = 10,000 cm^3
Answer. False.
lm = 100 cm

6. A ruler with a damaged end can be used to measure a length accurately.
Answer. True

D. Answer the following in a word or two or in a sentence.

Question 1.
Answer the following in a word or two or in a sentence. Name the unit which is commonly in both the MKS and CGS systems.
Answer:
Second (unit of time)

Question 2.
Name an instrument generally used to find the time interval between two events accurately.
Answer:
Stop watch.

Question 3.
If the alarm of a digital clock is set at 05:50, at wdiat time will the alarm ring during the day ?
Answer:
5.50 a.m.

Question 4.
At what temperature is the upper fixed point of a clinical thermometer kept?
Answer:
42° Cor 108° F

Question 5.
Write the formula for finding the average of a given set of observation.
Answer:
Average = $\frac{sum\,of\,all\,observations}{number\,of\,observations}$

E. Answer the following in short.

Question 1.
What is parallax error ?
Answer:
The error that can arise due to the wrong positioning of the eye while reading a scale is called parallax error.

Question 2.
Explain the working of an extension spring balance.
Answer:
When a body to be weighed is attached to the hook, the coil is stretched downwards. The distance through which the spring gets stretched is measured by a pointer and a graduated scale attached to the spring. The reading on the scale gives the weight of the object.

Question 3.
What do you mean by a mean solar day ?
Answer:
Mean solar day is the time taken by the earth to make one complete rotation about its own axis.

Question 4.
Why is there a slight bend in the capillary tube of a clinical thermometer near the bulb ?
Answer:
A slight bend or kink in the capillary tube of the clinical thermometer near the bulb ensures that the mercury does not move back into the bulb when the thermometer is taken out of a person's mouth for reading.

Question 5.
What is the function of the bulb in a thermometer ?
Answer:
The bulb in a thermometer is filled with mercury. When the bulb is heated, mercury in the bulb expands and rises up in the capillary tube. The height of the mercury gives the reading of temperature.

Question 6.
Describe any two means by which the actual capacity' of a measuring container can be

made less than the correct value by a dishonest trader.

Answer:

1. The base of the measuring container can be bend inwards by hammering which reduces the capacity of liquid it can hold.
2. Some lead can be poured into the measuring container.

F. Answer the following in detail.

Question 1.

What do you understand by the terms volume and capacity ? which is the most suitable unit for measuring the volume of a/an

(a) glass filled with water

(b) swimming pool

(c) air inside an inflated balloon

(d) cylinder of a car engine

Answer:

The total space occupied by an object is called its volume. The maximum volume of a liquid that a container can hold is known as its capacity.

Capacity and volume have same units – litres (L) and millilitres (mL).

(a) millilitre(mL)

(b) cubic metre (m^3) .

(c) millilitre (mL)

(d) cubic centimetre (cc) or cm^3

Question 2.

Explain in detail why railways and airlines use the 24-hour clock format.

Answer:

Railways and airlines use the 24-hour clock format as they operate round the clock (24 hour). The main features of 24-hour clock system are:

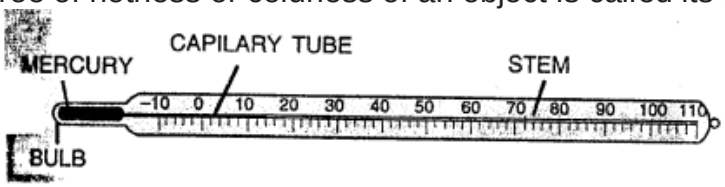
1. a.m. and p.m. are not used in order to avoid confusion.
2. Time is shown by 4 digits. The first two digits indicate the number of hours, and the next two digits indicate the number of minutes.
3. Time is expressed continuously from 00.00 (midnight) to 24:00.

Question 3.

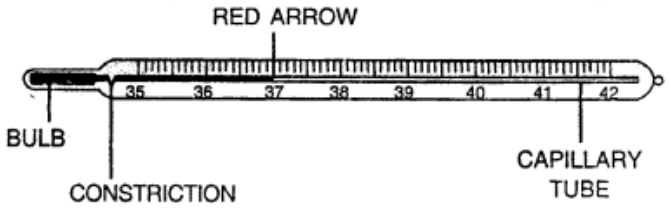
What do you understand by the term temperature? Distinguish betw een laboratory and clinical thermometers.

Answer:

The degree of hotness or coldness of an object is called its temperature.



Laboratory thermometer



Laboratory thermometer	Clinical thermometer
(i) It is used to measure temperatures for scientific purposes in a laboratory.	It is used to measure temperature of the human body.
(ii) The kink is not present.	A slight bend or kink is present near the bulb.
(iii) The lower fixed point is −10°C and upper fixed point is 110°C.	The lower fixed point is 35°C or 95° F and the upper fixed point is 42°C or 108° F.

Question 4.
When are approximations necessary in daily life and when should they be avoided ?
Answer:
An approximation or estimation is a reasonable guess about the measure of a physical quantity. For example, we use approximation in adding salt to food while cooking. We use approximation when we try to figure out the time it would take to reach a certain place by car. In our daily life, we use approximations in many situations. They are useful as they save time. But, since they are not accurate in measurements, they should be avoided in scientific studies and experimentation.

G. Give reasons for the following.

Question 1.
Body parts should not be used for correct measurements of an object.
Answer:
Body parts have different sizes from person to person and hence the value varies. Since, there is no uniformity or accuracy in the reading, body parts should not be used for correct measurement of an object.

Question 2.
Measurements are very important for life.
Answer:
We need to measure the quantities of most of the things around us to be able to take correct decisions regarding their utility. To find the exactness of an unknown quantity, we need its measurement.

Question 3.
Measuring units are standardized.
Answer:
Measuring units are standardized so that accurate measurement can be done and are accepted universally.

H. Solve the following numerical problems.

Question 1.
Express :
(a) 2.25mincm
(b)6L tn mL
(c) 8000 g in kg
Answer:

a. 2.25 m

$= 2.25 \times 100$ cm [As 1m = 100 cm]

$= 225$ cm

b. 6 l

$= 6 \times 1000$ ml [As 1 l = 1000 ml]

$= 6000$ ml

c. 8000 g

$= 8000 \div 1000$ kg [As 1000 g = 1 kg]

$= 8$ kg

Question 2.
20 one – rupee coins are placed one above the other. If their total height is 32 mm, find the thickness of one coin.
Answer:
Number of coins 20
Total height of coins = 32 mm

Thickness of one coin ?
Thickness of one coin = Height of all coins / Number of coins
$= \frac{32}{60}$
= 1.6 mm

Question 3.
A piece of wire is wound around a pencil 60 times. If tite total width of all the turns is 4 cm, find the diameter of the wire.
Answer:
Number of turns of wire = 60
Total width of turns of wire 4 cm
Diameter of the wire ?
Diameter of the wire = Total width of turns of wire / Number of turns of wire
$= \frac{4}{60}$
= 0.066 cm

Question 4.
Amit dipped a stone tied with a string in a measuring cylinder filled with water. If the initial level of water was 56 mL and after dipping the stone the final level of water was 78 mL, find the volume of the stone.
Answer:
Initial level of water = 56 mL
Final level of water = 78mL
Volume of the stone = ?
Volume of the stone = Final reading – Initial reading
= 78mL – 56 mL
= 22 mL

Question 5.
Grass is to be laid a rectangular field of dimensions 55 m × 45 m. Calculate the area of the field.
Answer:
Length of field = 55 m C
Breadth of field = 45 m
Area of rectangular field = length x breadth = 55 × 45 m^2
= 2,475 m^2

Question 6.
A lawn is in the shape of a square. Find the area covered by the lawn if each of its sides is 50 m.
Answer:
Length of each side = 50 m
Area of square lawn side × side

= 50 x 50 m^2
= 2500 m^2

Question 7.
An aeroplane leaves Bengaluru at 23:50 hours and reaches Chennal at 00.40 hours. Rewrite the statement using a 12- hour time format. Also find the duration of the flight.
Answer:
Aeroplane leaves Bengaluru at 11:50 p.m.
and reaches Chennai at 12:40 a.m.
Duration of the flight =50 minutes

Question 8.
The body temperature of a patient on Monday was102 °F and on Tuesday it was 104°F. What was the rise in temperature during these two days?
Answer:
Body temperature on Monday = 102°F
Body temperature on Tuesday = 104°F
Rise in temperature = 104 — 102°F 2°F

Question 9.
The masses of five marbles are 50 g, 55 g, 60 g, 65 g and 70 g. Find their average mass.
Answer:
The sum of masses of all marbles
= 50 g + 55 g + 60 g + 65 g + 70 g = 300 g
Number of marbles = 5
Average mass of a marble = sum of mass / no. of marbles
= 300 / 5 g
= 60 g

Question 10.
The rainfall in a city on each day of a week is recorded below. Find the average rainfall for the week.

Day	Mon	Tue	Wed	Thurs	Fri	Sat	Sun
Rainfall (in mm)	1.2	10.3	5.5	0.0	13.5	7.0	1.0

Answer:
The sum of recorded rain fall
1.2 mm + 10.3 mm + 5.5 mm+ 13.5 mm + 7 mm+ 1mm = 38.5 mm
Number of days = 7
Average rainfall of the week = sum of all observations / number of days
= 38.5 / 7 mm = 5.5 mm