AL-RAZI

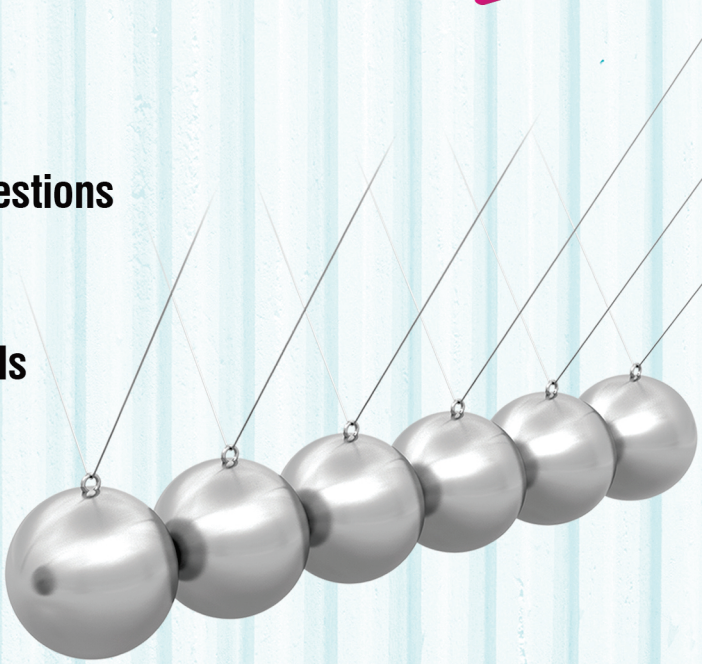
ACADEMIC Notes

Physics

Grade 9

Promising:

- Topical MCQs
- Topical Short Questions
- Solved Exercises
- Solved Numericals



Chapter 1 Physical Quantities and Measurements

1.1 Physical and Non-Physical Quantities

Multiple Choice Questions (MCQs)

1. The quantities which can be measured by tools is.
A Physical B Non-physical C Social D Understandable

2. The example of non-physical quantity is:
A Scalar B Physical C Vector D Wisdom

3. The quantity which has no dimension is:
A Physical B Social interaction C Length D Time

Short Questions

1. Define science.

Ans. **Science:** Field of observation and experimentation to understand the world around us is known as science.

2. Define physical quantities with examples?

Ans. **Physical quantities:** Some of quantities can be measured directly using some tools and instruments. These are called physical quantities.
Examples: Length, mass, time.

3. Define non-physical quantities with examples?

Ans. **Non-physical quantities:** Quantities cannot be measured using tools and instruments are called non-physical quantities.
Example: Love, affection, fear, wisdom, and beauty.

4. Does a non-physical quantities have dimension?

Ans. Dimension tells us what we are measuring but non-physical quantities can not be measured so, they have no dimensions.

5. Complete the table.

Ans.

Feature	Physical Quantity	Non-Physical Quantity
1. Measurement	Yes	No
2. Instrument used	Yes	No
3. Numerical value and unit	10 Newton	No
4. Examples	**1.** Mass **2.** Time	**1.** Fear **2.** Wisdom

1.2 Base and Derived Physical Quantities

Multiple Choice Questions (MCQs)

4. Identify base quantity:

A Speed B Area C Force D length

5. To avoid confusion in a measurement we need:

A observation B experiment C standard unit D all

Short Questions

1. Write the types of physical quantities?

Ans. They are two types of physical quantities.

Base quantities: The quantities, which can be expressed independently without the reference of any other quantity are called base quantities.

Examples: (a) length **(b)** mass **(c)** time

Derived Quantities: All the quantities which can be described in terms of one or more base quantities are called derived physical quantities.

Examples: Speed is a derived quantity which depends on distance and time.

2. Define measurement? What are the parts of a measurement?

Ans. Measurement: A measurement is a process of comparison of an unknown quantity with a widely accepted standard quantity.

Parts of a measurement: A measurement consists of two parts, a number and a unit. A measurement without unit is meaningless.

Example: If length of a path is 2 meter. Here 2 is a number and meter is a unit.

3. Define unit of a measurement with suitable example?

Ans. To avoid confusion in every measurement, there is a need of a standard (commonly acceptable) so that measurement by any person may result the same. This standard of measurement is known as a unit of measurement.

Examples: If height of a wall is measured by different people by standard metre rule, it will give same result.

1.3 International System of Units

Multiple Choice Questions (MCQs)

6. Which one is not a derived quantity:

A Speed B Time C Area D Velocity

7. International committee on weights and measure was held in:

A 1960 B 1965 C 1961 D 1919

8. Electric current is measured in:

A mole B kilogram C candela D Ampere

9. The unit of force is:

A Pascal B Nm C m^2 D N

10. The thickness of wire is measured in:

A km B m C cm D mm

11. The unit of electric charge is:

A Radian B Coulomb

C Meter per second D Pascal

12. The quantity 0.00004 can be written as:

A 4×10^5 B 4×10^{-5} C 4×10^6 D 0.4×10^{-7}

13. The prefix 'micro' is equal to:

A 10^{-3} B 10^{-6} C 10^{+3} D 10^{-9}

14. The prefix 'nano' is equal to:

A 10^{-3} B 10^{-6} C 10^{-9} D 10^{-12}

15. One pico is:

A 10^3 B 10^6 C 10^9 D 10^{-12}

Short Questions

1. What role S.I unit has played in the field of science and technology?

Ans. With a development in the field of science and technology, there is a need of commonly acceptable system of units all over the world which may help scientists and people to share and compare their information, observations and results easily. The use of SI measurements has met this need.

2. What is meant by international system (SI) of units?

Ans. The international committee on weights and measures, in 1961, recommended the use of a system consisted of seven base units known as international system of units, abbreviated as SI.

3. Define base units and derived units with examples?

Ans. **Base units:** The units of base quantities are known as base units.

Base units cannot be derived from one another and neither can they be resolved into anything more basic.

Example: Unit of time is sec and unit of mass is kg.

Derived Units: The units which can be expressed in terms of base units are called derived units.

Example: Area = length × breadth

$A = \text{metre} \times \text{metre}$

$A = m^2$

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

$$v = \frac{\text{metre}}{\text{sec}}$$

$v = ms^{-1}$

4. Draw a table of base quantities with their symbol and unit.

Sr.	Physical quantity	Unit	Symbol
1.	Length	metre	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Temperature	kelvin	K
5.	Electric current	ampere	A
6.	Intensity of light	candela	cd
7.	Amount of substance	mole	mol

5. What are prefixes? Give example?

Ans. **Prefixes:** Prefixes are the symbols added before SI unit to write units by power of 10, such as, milli, centi, kilo, mega, giga.

Prefixes		
Prefix	**Symbol**	**Powers of Ten**
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}

6. Write the unit of charge in terms of base unit ampere and second.

Ans. The rate of flow of charge is called current

$$I = \frac{Q}{t}$$

Here I is current, Q is charge and t is time.

So, $I \times t = Q$

Now the unit of current (I) is Ampere (A), unit of time (t) is second and unit of charge (Q) is coulomb. So,

Ampere.sec = coulomb

A.s = c

7. Express the unit of pressure "pascal" in some other units.

Ans. As pressure is defined as force per unit area of the surface.

$$P = \frac{F}{A}$$

Unit: $Pa = N/m^2$

So, N/m^2 is other unit of pressure.

8. Write the names of six prefixes most commonly used?

Ans. **(i)** nano = n = 10^{-9} **(ii)** micro = μ = 10^{-6}

(iii) pico = ρ = 10^{-12} **(iv)** kilo = k = 10^{3}

(v) mega = M = 10^{6} **(vi)** milli = m = 10^{-3}

1.4 Scientific Notation

Multiple Choice Questions (MCQs)

16. 1 Km = _____ .

A 100 m B 1000 m C 10 m D 1000 cm

17. The average distance from the sun to earth is:

A 1.38×10^{7} km B 1.38×10^{6} km

C 1.38×10^{8} km D 1.38×10^{9}

18. The diameter of hydrogen atom is:

A 5.2×10^{-11} m B 5.2×10^{-11} cm C 5.2×10^{-11} km D 5.2×10^{11} m

19. 1 tonne is equal to:

A 10 kg B 100 kg C 1000 kg D 1050 kg

20. The only base unit that has prefix is:

A Kilogram B Newton C Second D Pascal

21. The negative exponent has value:

A less than 1 B Greater than 1

C 1 D Between 1 and 2

22. Symbol appear in upper case for:

A Meter B Litre C Kilogram D Second

23. 100m is equal to:

A 1000 μm B 1000 cm C 100,000 mm D 1 km

Short Questions

1. Define scientific notation with example.

Ans. Scientific notation is an internationally accepted way of writing numbers in which numbers are recorded using the powers of ten or prefixes and there is only one non-zero digit before the decimal.

Example: The average distance from the Sun to the Earth is 138,000,000 km. In scientific notation, this distance would be written as 1.38×10^8 km.

2. Why we use scientific notation?

Ans. Scientific notation is a short way of representing very large or very small numbers. Otherwise, the values of many quantities, take up much space. They are difficult to read, their relative sizes are difficult to visualize and they are awkward to use in calculations. Their decimal places are more conveniently expressed as powers of 10.

3. Express the following into scientific notation.

a) 0.00534 m **b) 2574.32 kg**

c) 0.45 m **d) 0.004 kg** **e) 186000 s**

Ans. **a)** 0.00534 m $= 5.34 \times 10^{-3}$m

b) 2574.32 kg $= 2.57432 \times 10^{3}$kg

c) 0.45 m $= 4.5 \times 10^{-1}$m

d) 0.004 kg $= 4 \times 10^{-3}$kg **e)** 186000 s $= 1.86 \times 10^{5}$s

4. Write down the rules while using SI units and prefixes?

Ans. Following rules should be kept in mind while writing SI units and prefixes.

- Each unit is represented by a symbol not by an abbreviation. For example, for second s not sec.
- Symbols do not take plural form. For example, 10 mN.
- Full name of unit does not begin with capital letter. For example, metre, second, newton except Celsius.
- Symbols appear in lower case, m for metre.
- Symbols named after scientist's name have initial letters capital. For example, N for newton.
- Prefix is written before and close to SI unit. Example: ms.
- Units are written one space apart. For example, N m.
- Compound prefixes are not allowed. For example, 7 μμs should be written as 7 ps.

5. 100m is equal to:

(a) 1000 μm (b) 1000 cm (c) 100,000 mm (d) 1 km

Sol. (a) 1000 μm

$= 10^3 \times 10^{-6}$ m as $\mu = 10^{-6}$ m

$= 10^{-3}$ m

$= 0.001$ m

(b) 1000 cm

$= 10^3 \times 10^{-2}$ m as $c = 10^{-2}$

$= 10$ m

(c) 100.000 mm

$= 100 \times 10^3 \times 10^{-3}$ m as $m = 10^{-3}$

$= 100 \times 10^0$ m

$= 100 \times 1$ m

$= 100$ m

(d) 1 km

$= 1 \times 10^3$ m as $k = 10^3$

$= 1000$ m

So, correct option is 100,000 mm.

1.5 Length Measuring Instruments

Multiple Choice Questions (MCQs)

24. Least count of measuring tape is:

A 0.1 mm B 1 mm C 10 mm D 0.01 mm

25. The error due to incorrect position of eye is:

A Random error B Zero error

C Experimental error D Parallex error

26. Least count of vernier callipers is:

A 1 mm B 1 cm C 0.1 mm D 0.1 cm

27. Thickness of a book page is:

A 1×10^{-4} m B 9.1×10^{1} m C 1 mm D 10^{-2} m

28. Vernier callipers was invented by scientist:

A French B American C Greek D Russian

29. Length of vernier scale is:

A 10 mm B 0.1 mm C 9 mm D 0.01 mm

30. Least count of screw-gauge is:

A 1 mm B 0.1 mm C 0.01 mm D 0.01 cm

31. Pitch of the screw-gauge is:

A 1 mm B 0.5 mm C 0.1 mm D 0.01 mm

32. The range of vernier callipers is:

A 0.1 mm to 15 cm B 1 cm to 10 cm

C 1 m to 100 m D 0.01 mm to 2.5 cm

33. Digital electronic balance can measure upto:

A 0.1 mg B 10 mg C 1 mg D 0.01 mg

Short Questions

1. Define metre rule. What is its least count?

Ans. Metre rule: A metre rule is an instrument which is used to measure length of an object or distance between two points.

Least count: The least count of meter rule is 1 mm.

2. What is measuring tape? Write its least count.

Ans. Measuring Tape: The instrument which can measure length of an object or distance between two points from 1 mm to several metres is called measuring tape.

Least count: The least count of measuring tape is 1mm.

3. Define zero error of verneir callipers. Write its least count?

Ans. Zero error: On joining the jaws of verneir callipers, if the zeros of the main scale and vernier scale do not exactly coincide with each other then there is an error in the instrument called zero error.

Least count: The least count of verneir callipers is 0.1 mm or 0.01 cm.

4. Write types of zero error of verneir callipers? How they are corrected?

Ans. Following are the types of zero error of verneir callipers:

(i) Positive zero error: If the zero of the Vernier scale is on the right side of the zero of the main scale then this instrument will show slightly more than the actual length. It is called positive zero error. Hence, this zero error is subtracted from the observed measurement.

(ii) Negative zero error: If the zero of the Vernier scale is on the left side of the zero of the main scale, then instrument will show slightly less than the actual length. It is called negative zero error. Hence, the zero error is added in the observed measurement.

5. Define screw-gauge. What is its least count?

Ans. It is an instrument used to measure very small lengths such as diameter of a wire or thickness of a metal sheet.

$$\textbf{Least count} = \frac{\text{Pitch of the screw gauge}}{\text{No. of divisions on the circular scale}} = \frac{0.5 \text{ mm}}{50} = 0.01 \text{ mm}$$

6. Define zero error of a screw-gauge.

Ans. Zero error: If the zero of the circular scale coincides with horizontal line (index line) on joining the anvil and spindle, there is no zero error. If it is not exactly in front of the horizontal line of the main scale on joining the anvil and spindle then there is a zero error in the screw gauge.

7. Write types of zero error of screw-gauge. How are they corrected?

Ans. There are two types of zero errors of screw-gauge:

(i) Positive zero error: If zero of the circular scale is below the horizontal line then it will measure slightly more than the actual thickness. It is called positive zero error.

Correction: Zero error will be subtracted from the observed measurement.

(ii) Negative zero error: If the zero of the circular scale is above the horizontal line, then it will show slightly less than the actual thickness. It is called negative zero error.

Correction: The zero error will be added to the observed measurement.

8. What is parallax error? How it is removed?

Ans. Parallax error is the error arises due to incorrect position of eye when taking measurements. It is removed by keeping eye perpendicular to the scale reading.

9. Write down the laboratory safety rules.

Ans. Laboratory safety rules:

- Handle all apparatus and chemicals carefully and correctly. Always check the label on the container before using the substance it contains.
- Do not taste any chemical until instructed by the teacher.
- Do not eat, drink or play in the laboratory.
- Do not tamper with the electrical mains and other fittings in the laboratory. Never work with electricity near water.
- Don't place flammable substance near naked flames.
- Wash your hands after all laboratory work.

10. Which balance is more precise and why?

Ans. The most precise balance is the digital electronic balance. It can measure mass of the order of 0.1mg

11. Define pitch of screw-gauge.

Ans. When the thimble makes one complete turn, the spindle moves 0.5 mm (1 scale division) on the main scale which is called pitch of the screw gauge.

12. How length of an object is measured using a metre rule?

Ans. To measure the length of an object, the metre rule is placed in such a way that its zero coincides one edge of the object and then the reading in front of the other edge is the length of the object.

13. Define vernier callipers? Write the names of its scales.

Ans. **Vernier callipers:** It is an instrument used to measure small lengths down to 1/10th of a millimetre. It can be used to measure the thickness, diameter, width or depth of an object.

Scales of vernier callipers:

(a) A main scale which has marking of 1mm each.

(b) A Vernier (sliding) scale of length 9 mm and it is divided into 10 equal parts.

14. Write the names of different parts of a vernier callipers?

Ans. Different Parts of vernier callipers are:

(a) Main scale **(b)** Verneir scale

(c) Inside jaws **(d)** Outside jaws **(e)** Tail

15. Write formula to measure the length of an object using verneir callipers?

Ans. Formula to measure the length of an object using vernier callipers is.

Length of object = main scale reading + (least count × vernier scale reading)±Z.E

16. Write the names of different parts of screw gauge?

Ans. The names of different parts of screw gauge are:

(a) Anvil **(b)** Spindle **(c)** Sleeve **(d)** Thimble

(e) Ratchet **(f)** Horizontal or index line **(g)** circular scale

17. Write formula to measure the thickness of a steel sheet using screw gauge?

Ans. Thickness of a steel sheet can be measured by the formula.

Thickness = main scale reading + (circular scale reading × L.C) ± Z.E

1.6 Mass Measuring Instruments

Multiple Choice Questions (MCQs)

34. Physical balance is based on the principle of:

A Magnetism B Levers

C Floatation D Technology

35. Weight can be measured by directly by:

A Bean balance B Physical balance

C Electronic balance D Spring balance

Short Questions

1. Differentiate between mass and weight?

Ans. Difference between mass and weight:

Mass	Weight
(i) The amount of matter in a substance is called the mass.	**(i)** The weight of a body on the earth is the force with which the earth pulls the body towards itself.
(ii) It is a scalar quantity.	**(ii)** It is a vector quantity.
(iii) The amount of mass does not change when a body is moved from one place to another.	**(iii)** Weight depends on gravitational acceleration (g) and its magnitude changes with change of position.
(iv) Its unit is kg.	**(iv)** Its unit is N.
(v) It is measured by physical balance.	**(v)** It is measured by spring balance.

2. Define physical balance.

Ans. Physical balance: In laboratories, we use an instrument which is based on the principle of levers to measure the mass of unknown object. This instrument is called physical balance.

3. How mass of unknown object is measured with physical balance?

Ans. (i) Level base of the balance using levelling screws until the plumb line is exactly above the pointed mark.

(ii) Turn the knob so that the pans of the balance are raised up so its the beam stay horizontal and pointer at the centre of the scale. If not, turn the balancing screws on the beam so that it becomes horizontal.

(iii) Place the object to be weighed on the left pan.

(iv) Place the known weight from the weight box in the right pan using forceps.

(v) Adjust the weight so that pointer remains on zero or oscillates equally an both sides of the zero of the scale.

(vi) The total of standard masses (weights) is a measure of the mass of the unknown object.

4. Define: (a) Weight (b) Weighing

Ans. (a) Weight: The weight is the force by which the body is attracted towards the Earth.

(b) Weighing: The mass of an object is found by comparing it with known standard masses. This process is called weighing.

1.7 Time Measuring Instruments

Multiple Choice Questions (MCQs)

36. Least count of electronic watches is:

A 0.1 sec B 0.01 sec C 0.001 sec D 1 sec

37. Duration of an event is measured by:

A Metre rule B Stop watch
C Physical balance D Micrometer

Short Questions

1. What is a stop-watch? Write its types and least count?

Ans. Stop-watch: The duration of time of an event is measured by an instrument called stopwatch.

Types: There are two types of stop watches.

(a) Mechanical stop watch **(b)** Digital stop watch

Least count: Least count of mechanical stop watch is $\frac{1}{10}$ sec or 0.1 sec and least count of digital stop watch is $\frac{1}{100}$ sec or 0.01 sec.

2. Write types of clocks with their use and accuracy?

Ans.

Type of clock/watch	Use and accuracy
Atomic clock	Measures very short time intervals of about 10 seconds.
Digital stopwatch	Measures short time intervals (in minutes and seconds) to an accuracy to ±0.01 s.
Analogue stopwatch	Measures short time intervals (in minutes and seconds) to an accuracy to ±0.1 s.
Ticker-tape timer	Measures short time intervals of 0.02 s.
Watch/Clock	Measures longer time intervals in hours, minutes and seconds.
Pendulum clock	Measures longer time intervals in hours, minutes and seconds.
Radioactive decay clock	Measures (in years) the age of remains from thousands of years ago.

3. Write working and construction of stop-watch?

Ans. Construction: It contains two needles, one for seconds and other for minutes. The dial is divided usually into 30 big divisions each being further divided into 10 small divisions. Each small division represents one tenth (1/10) of a second.

Working: While using, a knob present on the top of the device is pressed. This results in the starting of the watch. The same knob is again pushed to stop it. After noting the reading, the same knob is again pressed to bring back the needles to the zero position.

1.8 Volume Measuring Instruments

Multiple Choice Questions (MCQs)

38. A measuring cylinder measures volume in:

A cm^3 B ml C cc D All of these

39. Meniscus of which liquid curves upward:

A Water B Milk C Mercury D Alcohol

40. In printers type, one point is equal to:

A 0.35 mm B 0.3 mm C 3 mm D 1 mm

41. Volume of solids can be measured by:

A Scientific method B Displacement method

C Research method D Technical method

Short Questions

1. What is measuring cylinder?

Ans. Measuring cylinder: It is a cylinder made of glass or transparent plastic with a scale divided in cubic centimetres (cm^3) or millilitres (mL) marked on it. It is used to find the volume of liquids and solids.

2. How volume of a liquid can be measured using measuring cylinder?

Ans. 1. Take a liquid in some container.

2. Pour liquid into measuring cylinder.

3. Note the position of liquid surface.

4. Read the reading written on the measuring cylinder.

5. This is the volume of the liquid.

3. How volume of solid can be measured by displacement can method?

Ans. (i) Take a liquid in which the given solid does not dissolve.

(ii) Note the initial position of liquid surface.

(iii) Put the solid in the cylinder containing liquid.

(iv) Note again the position of liquid surface in the cylinder which rises due to solid.

(v) The difference of the two readings is the volume of the solid.

1.9 Errors in Measurements

Multiple Choice Questions (MCQs)

42. How many types of experimental errors are there:

A 2 B 3 C 4 D 5

43. Which error arises due to unknown cause:

A Human error B Systematic error

C Random error D Zero error

44. The error that arises due to some definite rule is:

A Human error B Random error

C Systematic error D All of these

45. Air current balance may cause the balance to fluctuate in:

A Random error B Systematic error

C Human error D Zero error

Short Questions

1. Write types of experimental errors.

Ans. Usually, there are three types of experimental errors affecting the measurements.

(i) Human Errors **(ii)** Systematic Errors **(iii)** Random Errors

2. What is human error in a measurement?

Ans. Human Errors: Human errors occur due to personal performance, the limitation of the human perception such as the inability to perfectly estimate the position of the pointer on a scale.

3. How human error is reduced?

Ans. Minimization: Human error can be reduced by ensuring proper training, techniques and procedure to handle the instruments and avoiding environmental distraction or disturbance for proper focusing. The best way is to use automated or digital instruments to reduce the impact of human errors.

4. What is systematic error?

Ans. Systematic error: Systematic errors refer to an effect that influences all measurements of particular measurements equally. It occurs due to some definite rule. It may occur due to zero error of instrument, poor calibration of instrument or incorrect marking.

5. How systematic error is minimized?

Ans. Minimization: The effect of systematic error can be reduced by comparing the instrument with another which is known to be more accurate. Thus, a correction factor can be applied.

6. What is random error?

Ans. Random error: Random error is said to occur when repeated measurements of a quantity give different values under the same conditions. It is due to some unknown causes which are unpredictable.

7. How random error is minimized?

Ans. Minimization: The effect of random errors can be reduced by using several or multiple readings and then taking their average or mean value.

8. Identify Personal, Systematic and Random errors:

(i) Your eye level may move a bit while reading the meniscus.

(ii) Air current may cause the balance to fluctuate.

(iii) The balance may not be properly calibrated.

(iv) Some of the liquid may have evaporated while it is being measured.

Ans. (i) Eye level move a bit while reading the meniscus is **human error**.

(ii) Air current may cause the balance to fluctuate is **random error**.

(iii) The balance is not properly calibrated is **systematic error**.

(iv) Some of the liquid have evaporated while measuring is **random error**.

9. Why we need to measure error in a measurement?

Ans. We need to measure error in a measurement because measuring tools are never perfect. They inherit some error and measurements made by these tools differ from true value. To minimize this difference we measure the error and measurement.

1.10 Uncertainty in a Measurement

Multiple Choice Questions (MCQs)

46. Uncertainty in a measurement can be reduced by:

A Single step reading B Two step readings
C Multiple readings D Average of multiple readings

47. Uncertainty in a measurement can be indicated by:

A Significant digits B Doubtful digits
C Estimeated digits D Non-zero digits

48. Maximum uncertainty of ±0.05cm is equal to:

A 0.1cm B 0.5cm C 1cm D 0.01cm

Short Questions

1. What is meant by uncertainty in a measurement?

Ans. Uncertainty: Uncertainty in a measurement refers to the doubt within which the true value of the measured quantity is expected to lie.

2. What is the main reason of uncertainty in a measurement?

Ans. Reason: The main reason is the type of instrument being used. We know that every measuring instrument is calibrated to a certain smallest division and this fact puts a limit to the degree of accuracy which can be achieved while measuring with it.

3. How uncertainty in a measurement can be reduced?

Ans. The uncertainty in a measurement can be reduced by taking multiple readings and then finding the average value.

1.11 Significant Figures

Multiple Choice Questions (MCQs)

49. The significant digits are the digits which are:

A Estimated B Doubtful C Reliable D Non-reliable

50. Zeros on the left side of a measurement are:

A Significant B Not significant
C May significant D Doubtful

51. Number of significant figures in 3.50×10^4 m is:

A 4 B 3 C 2 D 5

Short Questions

1. What are significant figures?

Ans. Significant figures: In any measurement, the accurately known digits and the first doubtful digit are known-as significant figures.

2. Write down the rules to find the significant figures?

Ans. All digits from 1 to 9 are significant. However, zeros may or may not be significant. In case of zeros, the following rules apply:

(a) A zero between two digits is considered significant. For example in 5.06m, the number of significant figures is 3.

(b) Zeros on the left side of the measured value are not significant. For example, in 0.0034 m, the number of significant figures is 2.

(c) Zeros on the right side of a decimal are considered significant. For example, in 2.40 mm the significant digits are 3.

(d) If numbers are recorded in scientific notation, then all the digits before the exponent are significant. For example, in 3.50 104m, the significant figures are 3.

3. Name some repetitive processes occurring in nature which could serve as reasonable time standard.

Ans. (a) Rotation of earth about its axis.

(b) Revolution of moon around the earth.

(c) Radioactive decay **(d)** Solar cycle

4. How many significant figures are there in each of the following?

(a) 1.25×10^2m (b) 12.5m (c) 0.125 (d) 0.000125km

Ans. (a) 1.25×10^2m

There are 3 significant figures.

(b) 12.5m

There are 3 significant figures.

(c) 0.125

There are 3 significant figures.

(d) 0.000125km

There are 3 significant figures.

1.12 Precision and Accuracy

Multiple Choice Questions (MCQs)

52. Accuracy in a measurement is:

A Closeness to true value B Deviation from true value

C Smaller value D Larger value

53. Precision refers to:

A Closeness to true value B Biggest value
C Smallest value
D Closness of measurement to each other

54. Atomic clock measures the time interval of about:

A 10^{-16} seconds B 10^{-11} seconds C 10^{-6} seconds D 10^{16} seconds

55. Ticker tape timer measures the time interval of:

A 0.02 sec B 0.2 sec C 0.002 sec D 2 sec

56. Accuracy of analogue stopwatch is:

A ± 0.2 s B ± 0.02 s C ± 0.1 s D ± 0.01 s

57. Electronic timer can measure time upto:

A $\frac{1}{10}$ s B $\frac{1}{100}$ s C $\frac{1}{1000}$ s D $\frac{1}{10000}$ s

Short Questions

1. Differentiate between precision and accuracy.

OR Define the term precision and accuracy.

Ans. Precision: Generally, precision of a measurement refers to how close together a group of measurements actually are to each other.

Accuracy: Accuracy of a measurement refers to how close the measured value is to some accepted or true value.

1.13 Rounding off the digits

Multiple Choice Questions (MCQs)

58. If the number before the 5 is odd _____ is added to the last digit retained:

A 2 B 1 C 5 D 1.5

Short Questions

1. How a digit is rounded off? Give example?

Ans. A number is rounded off to a certain number of significant figures as:
If the last digit is more than 5, the retained digit is increased by one and if it is less than 5, it is retained as such.

For example:

(i) Round to 2 significant figures: 2.512×10^3 m.
2.5×10^3 m

(ii) Round to 3 significant figures: 3.4567×10^4 kg.
3.46×10^4 kg

2. How can we round the number if last digit is 5?

Ans. (i) If the number before 5 is odd, one is added to the last digit.

(ii) If the number before 5 is even. It remains the same.

Example: (a) 4.45 = 4.4 (b) 4.55 = 4.6

MCQ's Key

1.	A	**2.**	D	**3.**	B	**4.**	D	**5.**	C	**6.**	B	**7.**	C	**8.**	D	**9.**	D	**10.**	**D**
11.	B	**12.**	B	**13.**	B	**14.**	C	**15.**	D	**16.**	B	**17.**	C	**18.**	A	**19.**	C	**20.**	A
21.	A	**22.**	B	**23.**	C	**24.**	B	**25.**	D	**26.**	C	**27.**	A	**28.**	A	**29.**	C	**30.**	**C**
31.	B	**32.**	A	**33.**	A	**34.**	B	**35.**	D	**36.**	B	**37.**	B	**38.**	D	**39.**	C	**40.**	A
41.	B	**42.**	B	**43.**	C	**44.**	C	**45.**	A	**46.**	D	**47.**	A	**48.**	A	**49.**	C	**50.**	B
51.	B	**52.**	A	**53.**	D	**54.**	A	**55.**	A	**56.**	C	**57.**	D	**58.**	B				

EXERCISE

A. Multiple Choice Questions

1.1. The instrument that is most suitable for measuring the thickness of a few sheets of cardboard is a:

A metre rule B measuring tape

C Vernier Callipers D micrometer screw gauge

1.2. One femtometre is equal to:

A 10^{-9}m B 10^{-15}m C 10^{9}m D 10^{15}m

1.3. A light year is a unit of:

A light B time C distance D speed

1.4. Which one is a non-physical quantity?

A distance B density C colour D temperature

1.5. When using a measuring cylinder, one precaution to take is to:

A check for the zero error

B look at the meniscus from below the level of the water surface

C take several readings by looking from more than one direction

D position the eye in line with the bottom of the meniscus

1.6. Volume of water consumed by you per day is estimated in:

A millilitre B litre C kilogram D cubic metre

1.7. A displacement can is used to measure:

A mass of a liquid B mass of a solid

C volume of a liquid D volume of a solid

1.8. Two rods with lengths 12.321 cm and 10.3 cm are placed side by side, the difference in their lengths is:

A 2.02 cm B 2.0 cm C 2 cm D 2.021 cm

1.9. Four students measure the diameter of a cylinder with Vernier Callipers. Which of the following readings is correct?

A 3.4 cm B 3.475 cm C 3.47 cm D 3.5 cm

1.10. Which of the following measures are likely to represent the thickness of a sheet of this book?

A 6×10^{-25} m B 1×10^{-4} m C 1.2×10^{-15} m D 4×10^{-2} m

1.11. In a Vernier Callipers ten smallest divisions of the Vernier scale are equal to nine smallest divisions of the main scale. If the smallest division of the main scale is half millimetre, the Vernier constant is equal to:

A 0.5 mm B 0.1 mm C 0.05 mm D 0.001 mm

MCQ's Key

1.1	D	**1.2**	B	**1.3**	C	**1.4**	C	**1.5**	D	**1.6**	B
1.7	D	**1.8**	D	**1.9**	C	**1.10**	B	**1.11**	C		

B. Short Answer Questions.

1.1. Can a non-physical quantity be measured? If yes, then how?

Ans. No, non-physical quantities cannot be measured using tools and instruments.

1.2. What is measurement? Name its two parts.

Ans. Measurement: A measurement is a process of comparison of an unknown quantity with a widely accepted standard quantity.

Parts: A measurement consists of two parts. (a) Number (b) Unit

1.3. Why do we need a standard unit for measurements?

Ans. Use of SI measurements helps all scientists to share and compare their observations and results easily. Their values are fixed with reference to international standards.

1.4. Write the name of 3 base quantities and 3 derived quantities.

Ans.

Base Quantities	Derived Quantities
length	area
mass	volume
time	speed

1.5. Which Sl unit will you use to express the height of your desk?

Ans. S.I unit we use to express the height of desk is metre or cm because the height of desk most commonly used is in the range of 1cm to 100cm.

1.6. Write the name and symbols of all SI base units.

Ans.

Sr.	Physical quantity	Unit	Symbol
1.	Length	metre	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Temperature	kelvin	K
5.	Electric current	ampere	A
6.	Intensity of light	candela	cd
7.	Amount of substance	mole	mol

1.7. Why prefix is used? Name three sub-multiples and three multiple prefixes with their symbols.

Ans. Prefixes are used to write big quantities and small quantities more simply by power of 10.

Example: The quantity 50000000 m can be written as 5×10^7 m. Similarly, the quantity 0.00004 m can be written as 4×10^{-5} m.

Multiples	Sub-multiples
Kilo = k = 10^3	Milli = m = 10^{-3}
Mega = M = 10^6	Micro = μ = 10^{-6}
Giga = G = 10^9	Nano = n = 10^{-9}

1.8. What is meant by.

(a) 5 pm (b) 15 ns (c) 6 μm (d) 5 fs

Ans.

(a) 5 pm = 5×10^{-12}m as pico = p = 10^{-12}

(b) 15 ns = 15×10^{-9}s as nano = n = 10^{-9}

(c) 6 μm = 6×10^{-6}m as micro = μ = 10^{-6}

(d) 5 fs = 5×10^{-15}s as femto = f = 10^{-15}

1.9. (a) For what purpose a Vernier Callipers is used?
(b) Name its two main parts. (c) How is least count found?
(d) What is meant by zero error?

Ans. Vernier Callipers: It is an instrument used to measure small lengths down to 1/10th of a millimetre. It can be used to measure the thickness, diameter, width or depth of an object.

Parts: The two scales on it are:

(a) A main scale which has marking of 1mm each.

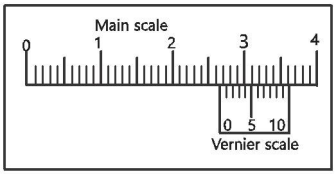
(b) A Vernier (sliding) scale of length 9 mm and it is divided into 10 equal parts.

Least count: Least count of a Vernier Callipers is the difference between one main scale division (M.S) and one Vernier scale (V.S) division.

Hence, Least count = 1 M.S div – 1V.S div
= 1mm – 0.9 mm = 0.1 mm

Zero error: On joining the jaws of verneir callipers if the zeros of the main scale and Vernier scale do not exactly coincide with each other then there is an error in the instrument called zero error.

1.10. State least count and Vernier scale reading as shown in the figure and hence, find the length.



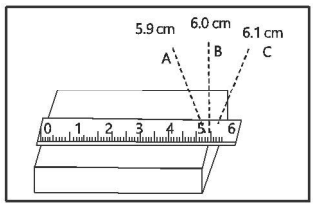
Ans. Least count: Least count of a Vernier Callipers is the difference between one main scale division (M.S) and one Vernier scale (V.S) division.

Hence, Least count = 1 M.S div – 1V.S div
= 1mm – 0.9 mm = 0.1 mm

Vernier scale reading: 5 × 0.01 cm = 0.05 cm

Length: Main scale reading + verneir scale reading
= 2.5 cm + 0.05 cm = 2.55 cm

1.11. Which reading out of A, B and C shows the correct length and why?



Ans. 6 cm is the correct reading.

Reason: While measuring the reading eye should be vertically above the reading point and at point B eye is vertically above.

C. Constructed Response Questions.

1.1. In what unit will you express each of the following?

(a) Thickness of a five-rupee coin: **mm**

(b) Length of a book **cm**

(c) Length of football field: **m**

(d) The distance between two cities: **km**

(e) Mass of five-rupee coin: **gram**

(f) Mass of your school bag: **kg**

(g) Duration of your class period: **minutes**

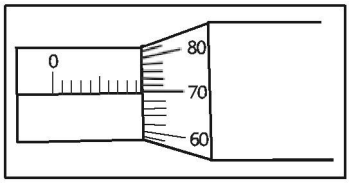
(h) Volume of petrol filled in the tank of a car. **litre**

(i) Time to boil one litre milk: **minutes**

1.2. Why might a standard system of measurement be helpful to a tailor?

Ans. As tailor has to measure the length of garments in metres and inches. So, standard system of measurement is very helpful for him to get more precise measurement with lesser uncertainty.

1.3. The minimum main scale reading of a micrometer screw gauge is 1 mm and there are 100 divisions on the circular scale. When thimble is rotated once, 1 mm is its measurement on the main scale. What is the least count of the instrument? The reading for thickness of a steel rod as shown in the figure. What is the thickness of the rod?



Sol. Pitch of screw guage = 1mm

Number of divisions on circular scale = 100

Least count = ?

$$\text{Least count} = \frac{\text{pitch of screw guage}}{\text{number of divisions on circular scale}}$$

$$= \frac{1\text{mm}}{100} = 0.01\text{mm}$$

Thickness of rod = Main scale reading + Circular scale reading × L.C

= 9 mm + 70 × 0.01 mm

= 9 mm + 0.70 mm

= 9.7 mm

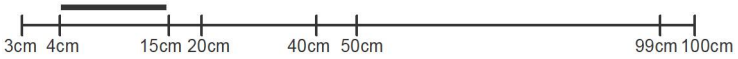
1.4. You are provided a metre scale and a bundle of pencils; how can the diameter of a pencil be measured using the metre scale with the same precision as that of Vernier Callipers? Describe briefly.

Ans. To measure the diameter of a pencil with metre scale with same precision as that of verneir callipers, we use unit mm as both instruments can measure in mm. Tie all pencils tightly and measure the width by metre rule, it will be total diametre of all pencils, then use formula

$$\text{Diametre of a pencil} = \frac{\text{Total width of all pencils}}{\text{Number of pencils}}$$

1.5. The end of a metre scale is worn out. Where will you place a pencil to find the length?

Ans. If one end of a metre rule is worn out we will choose other clear starting point. Now place one end of pencil at this point and note the positions on metre rule of the pencil's starting point and ending point and then take difference of both reading. This will be the length of pencil.



length of pencil = 15cm – 4cm = 11cm

1.6. Why is it better to place the object close to the metre scale?

Ans. It is better to place the object near to metre scale because it will:

(a) Reduce parallax error. **(b)** Increase the precision.

1.7. Why a standard unit is needed to measure a quantity correctly?

Ans. Standard unit is needed to measure a quantity correctly because standard unit is commonly acceptable all over the world and it makes easy to exchange scientific and technical information.

1.8. Suggests some natural phenomena that could serve as a reasonably accurate time standard.

Ans. **(a)** Rotation of earth about its axis.

(b) Revolution of moon around the earth.

(c) Radioactive decay

(d) Solar cycle

1.9. It is difficult to locate the meniscus in a wider vessel. Why?

Ans. It is difficult to measure the meniscus in wider vessel because surface of liquid become more flat which reduces the curvature of the meniscus and makes difficult to locate the meniscus.

1.10. Which instrument can be used to measure:

(i) Internal diameter of a test tube.

(ii) Depth of a beaker.

Ans. Verneir callipers is used to measure the internal diametre of a test tube and depth of a beaker is measured by using tail of verneir callipers.

D. Comprehensive Questions.

1.1. What is meant by base and derived quantities? Give the names and symbols of Sl base units.

Ans. **Base quantities:** The quantities, which can be expressed independently without the reference of any other quantity are called base quantities.

Derived Quantities: All the quantities which can be described in terms of one or more base quantities are called derived physical quantities.

Sr.	Physical quantity	Unit	Symbol
1.	Length	metre	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Temperature	kelvin	K
5.	Electric current	ampere	A
6.	Intensity of light	candela	cd
7.	Amount of substance	mole	mol

1.2. Give three examples of derived unit in Sl. How are they derived from base units? Describe briefly.

Ans. The examples of derived units:

(i) Area:

$$\text{Area} = \text{length} \times \text{length}$$

Units:

$$m^2 = m \times m$$

The unit of area is m^2 which is derived by multiplying unit of length(m) two times.

(ii) Speed:

$$\text{Speed} = \frac{\text{length}}{\text{time}}$$

Units:

Unit of speed is m/s which is derived by dividing unit of length and unit of time.

(iii) Volume:

$$\text{Volume} = \text{length} \times \text{length} \times \text{length}$$

Unit:

$$m^3 = m \times m \times m$$

Unit of volume is m^3 which is derived by multiplying unit of length(m) three times.

1.3. State the similarities and differences between Vernier Callipers and micrometer screw gauge.

Ans.

Similarities	Differences
(a) Both are used to measure small lengths.	(a) Measuring mechanism is different.
(b) Both are used to measure fractional part of 1m.	(b) Range of measurement is different.
(c) Both have same units cm or mm.	(c) Vernier callipers measure internal and external dimensions but screw gauge only measures external dimensions.

1.4. Identify and explain the reasons for human errors, random errors and systematic errors in experiments.

Ans. **Human errors:** Human error occurs due to personal performance. The limitation of the human perception such as the inability to perfectly estimate the position of the pointer on a scale.

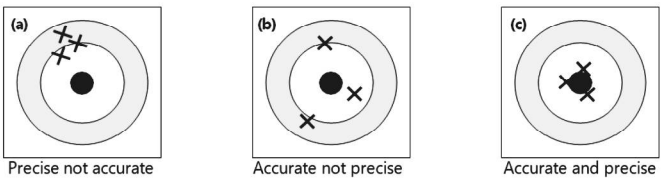
Random errors: Random error is said to occur when repeated measurements of a quantity give different values under the same conditions. It is due to some unknown causes which are unpredictable. Random error arises due to sudden fluctuation or variation in the environmental conditions.

Systematic errors: Systematic error refers to an effect that influences all measurements of particular measurements equally. It produces a consistence difference in reading. It occurs due to some definite rule. It may occur due to zero error of instrument, poor calibration of instrument or incorrect marking.

1.5. Differentiate between precision and accuracy of a measurement with examples.

Ans. **Precision:** Precision of a measurement refers to how close together a group of measurements are actually to each other.

Accuracy: Accuracy of a measurement refers how close the measured value is to true value.



Precise not accurate | Accurate not precise | Accurate and precise

Solved Numerical Examples

Example 1.1:

Solve the following:

(a) $\mathbf{5.123 \times 10^4\ m + 3.28 \times 10^5\ m}$

(b) $\mathbf{2.57 \times 10^{-2}\ mm - 3.43 \times 10^{-3} mm}$

Solution:

(a) $5.123 \times 10^4\ m + 3.28 \times 10^5\ m$

$= 5.123 \times 10^4\ m + 32.8 \times 10^4\ m$

$= (5.123 + 32.8)\ 10^4\ m$

$= 37.923 \times 10^4\ m$

$= 3.7923 \times 10^5\ m$

(b) $2.57 \times 10^{-2}\ mm - 3.43 \times 10^{-3} mm$

$= 2.57 \times 10^{-2}\ mm - 0.343 \times 10^{-2} mm$

$= (2.57 - 0.343)\ 10^{-2} mm$

$= 2.227 \times 10^{-2} mm$

$= 2.227 \times 10^{-2} \times 10^{-3} m$

$= 2.227 \times 10^{-5} m$

Example 1.2:

Find the value of each of the following quantities:

(a) $\mathbf{(4 \times 10^3\ kg)\ (6 \times 10^6 m)}$ **(b)** $\dfrac{6 \times 10^6\ m^3}{2 \times 10^{-2}\ m^2}$

Solution:

(a) $(4 \times 10^3\ kg)\ (6 \times 10^6 m) = (4 \times 6) \times 10^{3+6} kg\ m$

$= 24 \times 10^9 kg\ m$

$= 2.4 \times 10^1 \times 10^9 kg\ m$

$= 2.4 \times 10^{10} kg\ m$

(b) $\dfrac{6 \times 10^6\ m^3}{2 \times 10^{-2}\ m^2} = \dfrac{6}{2} \times 10^{6-(-2)} m^{3-2}$

$= 3 \times 10^8\ m$

E. Numerical Problems.

1.1 Calculate the number of second in a (a) day (b) week (c) month and state your answers using Sl prefixes.

Sol:

(a) day		**(b) week**	
one day	= 24 h	One week	= 7 days
	= 24 × 60 min		= 7 × 24 h
	= 24 × 60 × 60 sec		= 7 × 24 × 60 m
	= 86400 sec		= 7 × 24 × 60 × 60 s
	= 86.4×10^3 s		= 604800 s
	= 86.4 ks		= 604.8×10^3 s
			= 604.8 ks

(c) Month

One month = 30 days
= 30 × 24 h
= 30 × 24 × 60 m
= 30 × 24 × 60 × 60 s
= 2592000 s
= 2.592×10^6 s
= 2.592 Ms

1.2 State the answers of problem 1.1 in scientific notation.

Sol: (a) day

one day = 24 h
= 24 × 60 m
= 24 × 60 × 60 s
= 86400 s
= 8.64×10^4 s

(b) Week

One week = 7 days
= 7 × 24 h
= 7 × 24 × 60 m
= 7 × 24 × 60 × 60 s
= 604800 s
= 6.048×10^5 s

(c) Month

One month = 30 days

= 30 × 24 h

= 30 × 24 × 60 m

= 30 × 24 × 60 × 60 s

= 2592000 s

= 2.592×10^6 s

1.3 Solve the following addition or subtraction. State your answers in scientific notation.

(a) 4×10^{-4} kg + 3×10^{-5}kg

(b) 5.4×10^{-6}m – 3.2×10^{-5} m

Sol: (a) 4×10^{-4} kg + 3×10^{-5}kg

= $(4 \text{ kg} + 3 \times 10^{-1}\text{kg})10^{-4}$

= $(4 \text{ kg} + 0.3 \text{ kg})10^{-4}$

= 4.3×10^{-4} kg

(b) 5.4×10^{-6}m – 3.2×10^{-5} m

= $(5.4 \times 10^{-1}\text{m} – 3.2 \text{ m})10^{-5}$

= $(0.54 \text{ m} – 3.2 \text{ m})10^{-5}$

= $– 2.66 \times 10^{-5}$ m

1.4 Solve the following multiplication or division. State your answers in scientific notation.

(a) $(5 \times 10^4 \text{ m}) \times (3 \times 10^{-2} \text{ m})$

(b) $\frac{6 \times 10^8 \text{ kg}}{3 \times 10^4 \text{ m}^3}$

Sol: (a) $(5 \times 10^4 \text{ m}) \times (3 \times 10^{-2} \text{ m})$

= $15 \times 10^{4-2} \text{ m}^2$

= $15 \times 10^2 \text{ m}^2$

= $1.5 \times 10^1 \times 10^2 \text{ m}^2 = 1.5 \times 10^3 \text{ m}^2$

(b) $\frac{6 \times 10^8 \text{ kg}}{3 \times 10^4 \text{ m}^3}$

= $2 \times 10^{8-4} \text{ kgm}^{-3}$

= $2 \times 10^4 \text{ kgm}^{-3}$

1.5 Calculate the following and state your answer in scientific notation.

$$\frac{(3\times10^{2}\ \text{kg})\times(4.0\ \text{km})}{5\times10^{2}\ \text{s}^{2}}$$

Sol:

$$= \frac{(3\times10^{3}\,\text{kg})(4.0\text{km})}{5\times10^{2}\,\text{s}^{2}}$$

$$= \frac{(3\times10^{3}\,\text{kg})(4\times10^{3}\,\text{m})}{5\times10^{2}\,\text{s}^{2}}$$

$$= \frac{12\times10^{3+3-2}\,\text{kgms}^{-2}}{5}$$

$$= 2.4 \times 10^{4}\ \text{kg ms}^{-2}$$

1.6 State the number of significant digits in each measurement.

(a) 0.0045 m **(b) 2.047 m**

(c) 3.40 m **(d) 3.420×10^{4}m**

Sol:

(a) 0.0045 m

Number of significant figure is 2

(b) 2.047 m

Number of significant figures is 4.

(c) 3.40 m

Number of significant figures is 3

(d) 3.420×10^{4}m

Number of significant figures is 4

1.7 Write in scientific notation:

(a) 0.0035 m **(b) 206.4×10^{2} m**

Sol: **(a)** 0.0035 m

$= 3.5 \times 10^{-3}$ m

(b) 206.4×10^{2} m

$= 2.064 \times 10^{2} \times 10^{2}$ m $= 2.064 \times 10^{4}$ m

1.8 Write using correct prefixes:

(a) 5.0×10^{4} m **(b) 580×10^{2} g**

(c) 45×10^{-4}s

Sol: **(a)** 5.0×10^{4} m

$= 0.5 \times 10^{-1} \times 10^{4}$ m

$= 0.5 \times 10^{3}$ m

= 0.5 km

Note: Given value should be 5.0×10^{4} m for the given answer.

(b) 580×10^2 g

$= 58.0 \times 10^1 \times 10^2$ g

$= 58 \times 10^3$ g = 58 kg

(c) 45×10^{-4}s

$= 4.5 \times 10^1 \times 10^{-4}$s

$= 4.5\ 10^{-3}$s = 4.5 ms

1.9 Light year is a unit of distance used in Astronomy. It is the distance covered by light in one year. Taking the speed of light as 3.0 × 10 ms, calculate the distance.

t = 1 year

$v = 3 \times 10^8\ ms^{-1}$

S = ?

Sol: t = 1 year

t = 365 days

t = 365 × 24 h

t = 365 × 24 × 60 m

t = 365 × 24 × 60 × 60 s

t = 31536000 s $\Rightarrow$ $t = 3.1536 \times 10^7$ s

Now,

$S = v \times t$

$S = 3 \times 10^8\ ms^{-1} \times 3.1536 \times 10^7$ s

$S = 9.4608 \times 10^{8+7}$ s

$S = 9.4608 \times 10^{15}$ m

1.10 Express the density of mercury given as 13.6 g cm^{-3} in kg m^{-3}.

Sol: $d = 13.6\ gcm^{-3}$

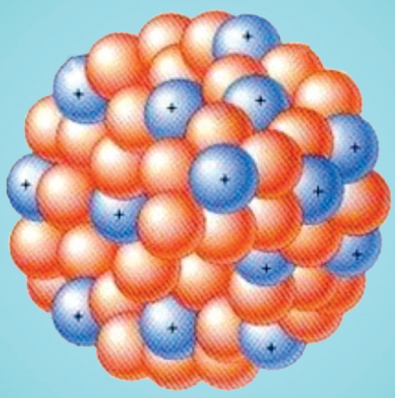
$$d = \frac{13.6}{1000} \times (10^2)^3 kgm^{-3}$$

$$d = \frac{13.6 \times 10^6}{10^3} kgm^{-3}$$

$d = 13.6 \times 10^{6-3}\ kgm^{-3}$

$d = 1.36 \times 10^1 \times 10^3\ kgm^{-3}$

$d = 1.36 \times 10^4\ kgm^{-3}$



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