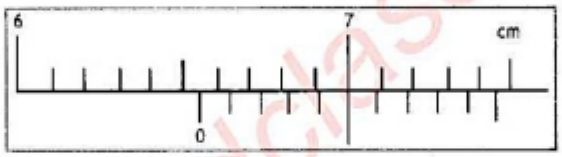
# UNIT 1 Physical Quantities and Measurement

## Section A Multiple Choice Questions (M.C.Qs)

***Tick mark (✓) the correct answer:***

01. *The following figure shows part of a Vernier scale, what is the reading on the Vernier scale?*

(a) 6.50cm (b) 6.55cm (c) 7.00cm (d) 7.45cm

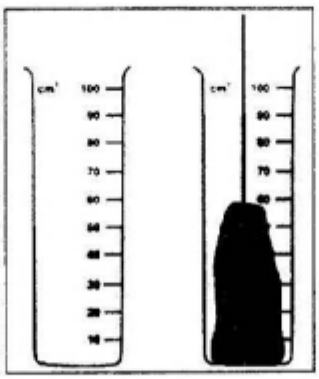



02. *Ten identical steel balls, each of mass 27g, are immersed in a measuring cylinder having 20cm³ of water. The reading of water level rises to 50cm³. What is the density of the steel?*

(a) 0.90gm/m³ (b) 8.1gm/cm³ (c) 9.0gm/cm³ (d) 13.5gm/cm³

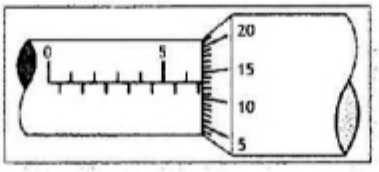
03. *An object of mass 100g is immersed in water as shown in the following figure, what is the density of the material from which object is made?*

(a) 0.4gm/cm³ (b) 0.9gm/cm³ (c) 1.1gm/cm³ (d) 2.5gm/cm³



04. *What is the reading of this micrometer in the following figure?*

(a) 5.43mm (b) 6.63mm (c) 7.30mm (d) 8.13mm



## PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

05. *A chips wrapper is 4.5 cm long and 5.9cm wide. Its area upto significant figure will be:*
(a) $30cm^2$ (b) $28cm^2$ (c) $26.55cm^2$ (d) $32cm^2$

06. *A worldwide system of measurements in which the units of base quantities were introduced is called:*
(a) Prefixes (b) International system of units
(c) Hexadecimal system (d) None of above

07. *All accurately known digits and first doubtful digit in an expression are known as:*
(a) non-significant figures (b) significant figures
(c) estimated figures (d) crossed figures

08. *If zero line of Vernier scale coincides with zero of main sale, then zero error is:*
(a) positive (b) zero (c) negative (d) one

09. *Zero error of the instrument is:*
(a) systematic error (b) human error (c) random error (d) classified error

10. *Length, mass, electric current, time, intensity of light and amount of substance are examples of:*
(a) base quantities (b) derived quantities (c) prefixes (d) quartile quantities

11. *Physics is the branch of science which observes the nature represents it mathematically and conclude with the:*
(a) observation (b) calculation (c) experiment (d) all of them

12. *Physicists are categorized into:*
(a) two categories (b) three categories (c) four categories (d) five categories

13. *The branch of physics that mainly concerned with the laws of motion and gravitation is called:*
(a) mechanics (b) thermodynamics (c) astrophysics (d) geophysics

14. *This branch of physics deals with heat and temperature and their relation to energy and work.*
(a) mechanics (b) thermodynamics (c) astrophysics (d) geophysics

15. *It is the study of properties of charges in rest and motion.*
(a) Mechanics (b) Atomic physics (c) Magnetism (d) Electricity

16. *It deals with the constituents, structure, behavior and interaction of atomic nuclei.*
(a) Atomic physics (b) Particle physics (c) Nuclear physics (d) Plasma physics

17. *It studies the elementary constituents of matter and radiation, and the interaction between them.*
(a) Atomic physics (b) Particle physics (c) Nuclear physics (d) Plasma physics

18. *The study of celestial objects with the help of laws of physics is known as:*
(a) geophysics (b) particle physics (c) nuclear physics (d) astrophysics

19. *The study of state of mater and its properties is known as:*
(a) mechanics (b) plasma physics (c) thermodynamics (d) atomic physics

20. *The study of internal structure of earth is known as:*
(a) mechanics (b) plasma physics (c) geophysics (d) atomic physics

21. *Physical quantities which cannot be explained by other physical quantities are called:*
(a) fundamental physical quantities (b) derived physical quantities
(c) prefix physical quantities (d) quartile physical quantities

22. *Physical quantities which are explained on the basis of fundamental physical are called:*
(a) fundamental physical quantities (b) derived physical quantities
(c) prefix physical quantities (d) quartile physical quantities

## PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

23. *Volume, velocity, force, density, and acceleration are examples of:*
(a) derived quantities (b) base quantities (c) prefixes (d) quartile quantities

24. *Use of every instrument is restricted by smallest measurement that it can perform which is called:*
(a) zero count (b) smallest count (c) least count (d) minimum count

25. *1000 m = :*
(a) 10 km (b) 10 cm (c) 1 cm (d) 1 km

26. *10 mm = :*
(a) 1 km (b) 1 cm (c) 1 m (d) 1 ft

27. *The minimum distance between two points lying on same plane is called:*
(a) length (b) displacement (c) vector (d) scalar

28. *On meter rule each cm is divided further in to 10 divisions which are called:*
(a) kilometer (b) meter (c) millimeters (d) centimeter

29. *The smallest reading a meter rule can measure up to:*
(a) 1 inch (b) 1 mm (c) 1 cm (d) 1 m

30. *Zero mark on vernier scale is slightly to the right than the zero error is called:*
(a) zero error (b) neutral zero error (c) positive zero error (d) negative zero error

31. *From the reading, the positive zero error is:*
(a) added (b) subtracted (c) multiplied (d) divides

32. *1000mg = :*
(a) 1 g (b) 1 kg (c) 1 lb (d) 1 mg

33. *Numbers in Scientific Notation are made up of:*
(a) two parts (b) three parts (c) four parts (d) five parts

34. *0.000 000 000 000 000 000 000 000 000 911 kg*
(a) $9.11 \times 10^{-30}$kg (b) $0.911 \times 10^{-30}$ (c) $0.911 \times 10^{-31}$ (d) $9.11 \times 10^{-31}$

35. *1 $m^3$ =:*
(a) 10 liter (b) 100 liter (c) 1000 liter (d) 10000 liter

36. *Volume of rectangular block = :*
(a) length + width + height (b) length × width × height
(c) length + width × height (d) length × width + height

37. *Volume of a cylinder = :*
(a) π x radius$^2$ × height (b) π x radius × height (c) π x radius$^2$ × height$^2$ (d) π x radius × height$^2$

38. *The term density of a substance is defined as:*
(a) mass × volume (b) mass + volume (c) $\frac{\text{mass}}{\text{volume}}$ (d) $\frac{\text{volume}}{\text{mass}}$

39. *The S.I unit for density is:*
(a) kg.$m^3$ (b) $kg^3$.m (c) $m^3$/kg (d) kg/$m^3$

40. *The density of Aluminium is 2.70 gm/$cm^3$ which is equal to:*
(a) 20.7 kg/$m^3$ (b) 27 kg/$m^3$ (b) 270 kg/$m^3$ (d) 2700 kg/$m^3$

41. $\frac{\textit{density of a substance}}{\textit{density of water}}$ *is called:*
(a) relative density (b) specific gravity (c) Both 'a' & 'b' (d) None of them

42. *The numbers of reliably known digits in a value are known as:*
(a) significant figures (b) least count (c) zero error (d) reliable numbers

43. *0.00000034 has:*
(a) 2 significant figures (b) 6 significant figures
(c) 8 significant figures (d) 9 significant figures

44. *200 has:*
(a) 1 significant figure (b) 2 significant figures
(c) 3 significant figures (d) no significant figures

45. *5.00 has:*
(a) 1 significant figure (b) 2 significant figures
(c) 3 significant figures (d) no significant figures

46. *In the number 0.00509 how many significant numbers are there?*
(a) 2 significant figures (b) 3 significant figures
(c) 5 significant figures (d) 6 significant figures

47. *'Mole' is a unit of:*
(a) electric current (b) temperature (c) luminous intensity (d) amount of substance

48. *The unit of luminous intensity is:*
(a) Kelvin (b) candela (c) mole (d) Ampere

## Answers

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (b) | 2. | (c) | 3. | (d) | 4. | (b) | 5. | (c) | 6. | (b) | 7. | (b) |
| 8. | (b) | 9. | (a) | 10. | (a) | 11. | (c) | 12. | (b) | 13. | (a) | 14. | (b) |
| 15. | (d) | 16. | (c) | 17. | (b) | 18. | (d) | 19. | (b) | 20. | (c) | 21. | (a) |
| 22. | (b) | 23. | (a) | 24. | (c) | 25. | (d) | 26. | (c) | 27. | (a) | 28. | (c) |
| 29. | (b) | 30. | (c) | 31. | (b) | 32. | (a) | 33. | (b) | 34. | (d) | 35. | (c) |
| 36. | (b) | 37. | (a) | 38. | (c) | 39. | (d) | 40. | (d) | 41. | (c) | 42. | (a) |
| 43. | (a) | 44. | (a) | 45. | (c) | 46. | (b) | 47. | (d) | 48. | (b) | | |

## Section B & C Short & Detailed Answer Questions

**Q.1** ***What is science?***

*Ans:* ***Science:*** The word science refers to the study of a fact by collecting information through observation, presenting it in a mathematical way, justifying the idea with experiment and finally making a conclusion about the fact.

**More Information:** The word 'Physics' derived from ancient Greek 'physicos' meaning 'knowledge of nature'.

**Q.2** ***Define Physics.***

*Ans:* ***Physics:*** One of the most basic and ancient science is the Physics. It can be defined as:
Physics is the branch of science which observes the nature represents it mathematically and conclude with the experiment.
In other words, Physics is the branch of science which deals with studies of matter its composition, properties, and interaction with energy.
It deals with the behaviour and structure of matter and the energy that derives from matter.
Physics is the branch of natural science that studies matter, its motion, its behaviour through space and time and the related entities of energy and force. Physics is one of the most fundamental scientific disciplines, and its main goal is to understand how the universe behaves.

**Q.3 *In how many categories physicists are categorized?***

*Ans:* Physicists are categorized into two categories: those who observe the nature solve its mysteries with available and missing information, present their theories with mathematical approach. They are known as theoretical physicists and other are more interested to test those theories with experiments are known as experimental physicists.

**Q.4 *Name and define the branches of Physics.***

*Ans:* Since from the beginning of the universe, the structure of universe is very straight forward, the classification of physics was not that much easy but as the physicists explained the universe, they classified Physics into many branches. These branches show the spectrum and scope of Physics around us and help scientists to describe ideas in a well-organized way. The branches of Physics are classified on the basis of different areas of study with different approaches. The main branches of Physics are as follows.

**Mechanics:** This branch of physics is mainly concerned with the laws of motion and gravitation.

**Thermodynamics:** Thermodynamics deals with heat and temperature and their relation to energy and work.

**Electricity:** Electricity is the study of the properties of charges in rest and motion.

**Magnetism:** Magnetism is the study of the magnetic properties of materials.

**Atomic Physics:** Atomic physics deals with the composition structure and properties of the atom.

**Optics:** Optics studies physical aspects of light and its properties with the help of optical instruments.

**Sound:** Sound is the study of production, properties and application of sound waves.

**Nuclear Physics:** Nuclear physics deals with the constituents, structure, behaviour and interaction of atomic nuclei.

**Particle Physics:** Particle Physics studies the elementary constituents of matter and radiation, and the interaction between them.

**Astrophysics:** The study of celestial objects with the help of laws of physics is known as Astrophysics.

**Plasma Physics:** The study of state of mater and its properties is known as Plasma Physics.

**Geophysics:** The study of internal structure of earth is known as Geophysics.

**Quote:**

"No one undertakes research in physics with the intention of winning a prize. It is the joy of discovering something no one knew before".
*Stephen Hawking*

**Q.5 *What is the importance of Physics?***

*Ans:* ***Importance of Physics in Science, Technology and Society:*** Society's reliance on technology represents the importance of physics in daily life. Many aspects of modern society would not have been possible without the important scientific discoveries made in the past. These discoveries became the foundation on which current technologies were developed.

Discoveries such as magnetism, electricity, conductors and others made modern conveniences, such as television, computers, smartphones, medical instruments, other business and home technologies possible. Moreover, modem means of transportation, such as aircraft and telecommunications, have drawn people across the world closer together all rely on concepts of physics.

It is a matter of fact that Physics can be considered as the mother of all sciences. The beauty of physics lies in its laws that govern this whole universe from an atom to large scale galaxies and in its experiments from home to large scale experiment labs.

### Q.6 What are physical quantities?

**Ans:** Physics is much concerned with matter and energy and the interaction between them which is explained with the help of describing the mathematical relations between various physical quantities. All physical quintiles are important for describing the nature around us.

***Definition:*** Physics define mathematical relation between physical quantities. A physical quantity is a physical property of a phenomenon, body, or substance that can quantify by measurement.

A physical quantity is a physical property of a phenomenon, body, or substance that can quantify by measurement.

### Q.7 Define fundamental and derived physical quantities.

**Ans:** Physical quantities are classified into two categories:

(i) Fundamental quantities (ii) Derived physical quantities

***Fundamental Quantities:*** Physical quantities which cannot be explained by other physical quantities are called fundamental physical quantities.

There are seven fundamental physical quantities and are listed in the following table along with their units.

*Table: Fundamental quantities and their S.I units*

| Fundamental quantities | S.I Unit | Symbol of Unit |
|---|---|---|
| Length | meter | m |
| Mass | Kilogram | kg |
| Time | second | s |
| Electric current | Ampere | A |
| Temperature | Kelvin | K |
| Amount of substance | mole | mole |
| Luminous intensity | candela | cd |

**More Information:**

Some Physical quantities are unit–less, such as electric modulus, plane angle and solid angle.

***Derived Quantities:*** Physical quantities which are explained on the basis of fundamental physical quantities are called derived physical quantities.

*Table: Derived quantities and their units*

| Derived quantities | S.I Unit | Symbol of Unit |
|---|---|---|
| Volume | cubic mater | $m^3$ |
| Velocity | meter per second | m/s |
| Force | Newton | N |
| Density | kilogram per cubic meter | $kg/m^3$ |
| Acceleration | meter per second square | $m/s^2$ |

### Q.8 What do you know about scientific or physical instruments?

**Ans:** All physical quantities are either calculated mathematically or measured through an instrument. Scientists, engineers, doctors and others like blacksmiths, carpenters, and goldsmiths even the workers and ordinary human measure those physical quantities with the help of instruments. For

instance, our doctor uses a thermometer to tell our body temperature, a carpenter uses the inch tape to measure the length of wood required for furniture.

A puncture mender uses air gauges to check the air pressure in the tyre. Similarly, a chemical engineer uses a hydrometer for describing the density of a liquid.

Measuring the physical quantity correctly with an instrument is not an easy task for scientists and engineers. Scientists are seriously concerned with the accuracy of the instrument and its synchronization. Moreover, the instrument they design mostly for their own sake of research which readably goes on to the commercial market. Many of the instruments we use today are inventions of pioneers of science. Usually, the basic physical quantities that we use in our daily life are measured with basic and simple instruments.

**More Information:**

The notion of physical dimension of a physical quantity was introduced by Joseph Fourier in 1822 by convention; physical quantities are organized in a dimensional system built upon base quantities, each of which is regarded as having its own dimension.

**Q.9 *Define least count.***

*Ans:* ***Least Count:*** Use of every instrument is restricted by the smallest measurement that it can perform which is called least count.

**Q.10 *Define length and their units.***

*Ans:* If there is any measurement that has proven to be useful to humanity, it is length. For example units of length include the inch, foot, yard, mile, meter etc.

***Definition of Length:*** The length is defined as the minimum distance between two points lying on the same plane.

***S.I. Unit of Length:*** The meter (m) is the S.I unit of length and is defined as:

The length of the path travelled by light in vacuum during the time interval of 1/299 792 458 of a second.

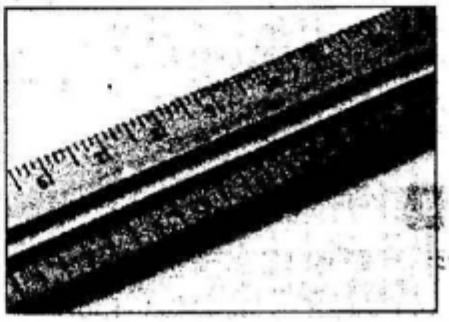
The basic measurement of length can be obtained with the help of a meter rod or an inch tape.

**More Information:**

1000m =1km, 100cm = 1m, 1cm = 10mm, 1 inch = 2.53cm,
12 inch = 1 ft, 1 yard = 3 ft

**Q.11 *What is a meter rule? How can we use a meter rule to measure length?***

*Ans:* ***Meter Rule:*** A meter rule is a device that is used to measure the length of different objects. A meter rule of length 1m is equal to 100 centimetres (cm). On meter rule, each cm is divided further into 10 divisions which are called millimetres (mm). So, a meter rule can measure up to 1mm as the smallest reading. It is made up of a long rigid piece of wood or steel.

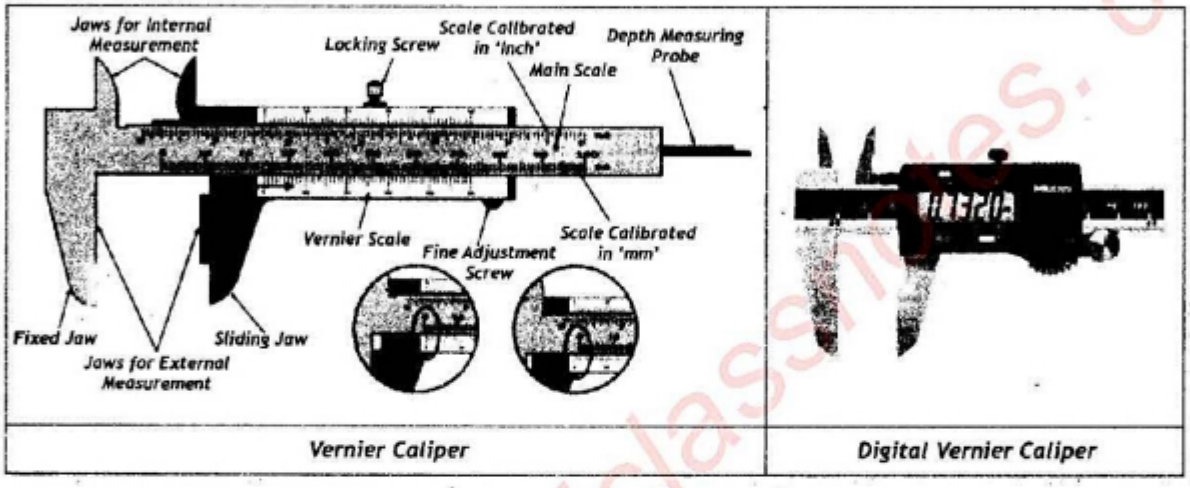


The zero-end of the meter rule is first aligned with one end of the object and the reading is taken where the other end of the object meets the meter rule.

## PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

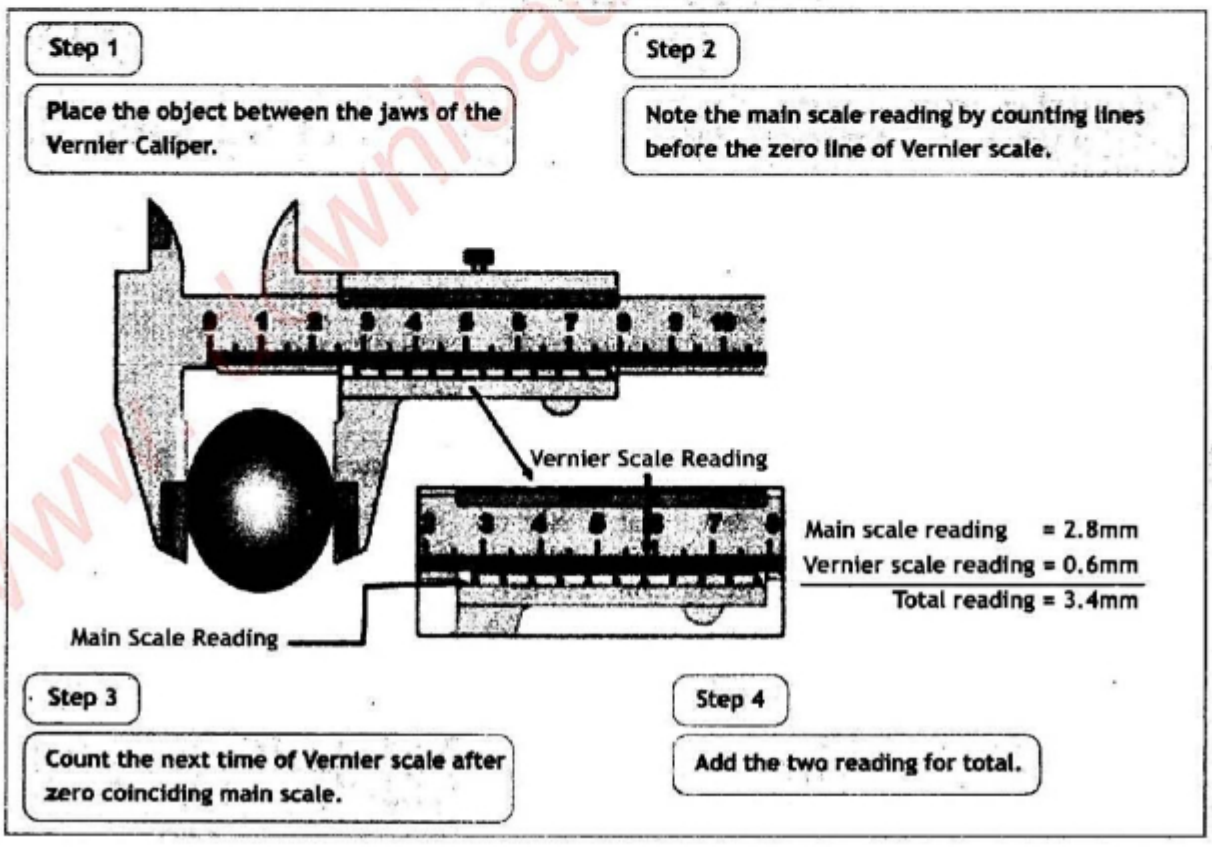
**Q.12 What is a Vernier Caliper? How can we read it?**

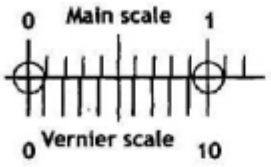
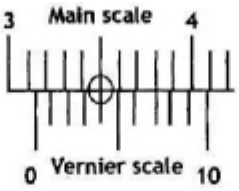
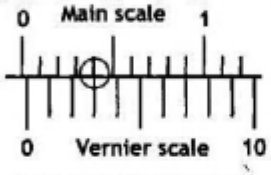
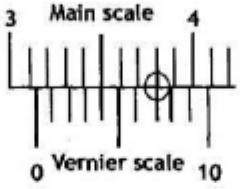
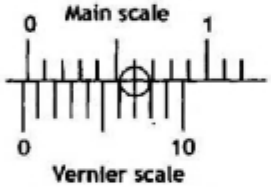
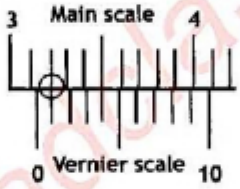
**Ans:** ***Vernier Caliper:*** The Vernier Caliper is a precision instrument that can be used to measure internal and external distance extremely accurate. It has both an imperial and metric scale. A Vernier caliper has main jaws that are used for measuring external diameter, as well as smaller jaws that are used for measuring the internal diameter of objects. Some models also have a depth gauge. The main scale is fixed in place, while the Vernier scale is the name for the sliding scale that opens and closes the jaws.




Vernier Caliper | Digital Vernier Caliper

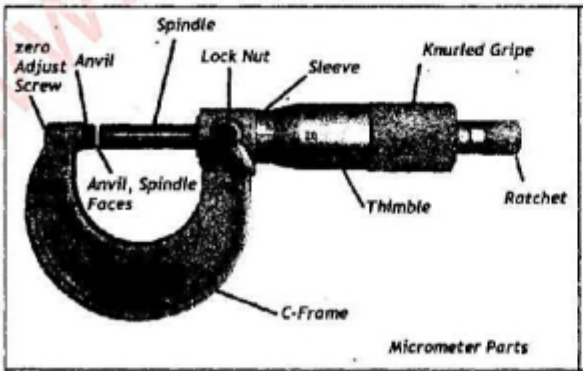
**Reading a Vernier Caliper**



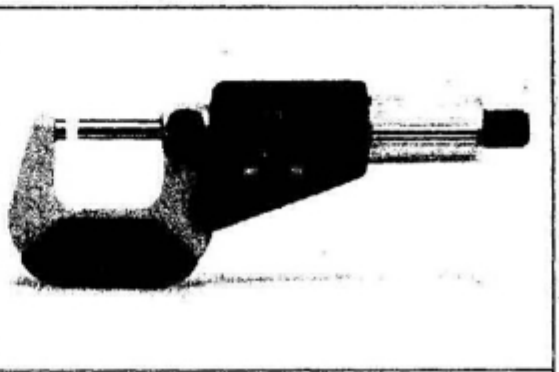
| CHECKING FOR ZERO ERROR | OBSERVING READING | CORRECTED READING |
|---|---|---|
|  Two zero marks coincide No zero error. |  Reading = 3.14cm | 3.14cm (No zero error No correction required) |
|  zero mark on vernier scale is slightly to the right Zero error is 0.03 |  Reading = 3.17cm | 3.17cm-(+0.03)=3.14cm (The positive zero error is subtracted from reading) |
|  Zero mark on vernier scale is slightly to the left. Zero error of -0.07 |  Reading = 3.11cm | 3.11cm -(-0.07) =3.18cm (Negative zero error is added to the reading) |

## Q.13 What is a Micrometer Screw Gauge? How can we read it?

*Ans:* ***Micrometer Screw Gauge:*** Screw gauge is extensively used in the engineering field for obtaining precision measurements. Micrometer screw gauge is used for measuring extremely small dimensions. A screw gauge can even measure dimensions smaller than those measured by a Vernier Caliper. Micrometer Screw gauge works on the simple principle of converting small distances into larger ones by measuring the rotation of the screw. This "Screw" principle facilitates reading of smaller distances on a scale after amplifying them.




Screw Guage



Digital Screw Guage

# PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

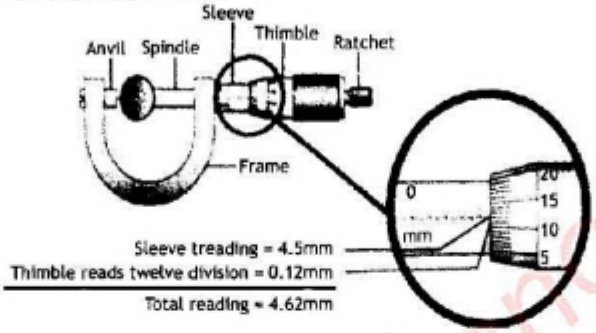
## Reading A Micrometer Screw Gauge

**Step 1**

Turn the thimble until the anvil and the spindle gently grip the object. Then turn the ratchet until it starts to click.

**Step 2**

Take the main scale reading at the edge of the thimble.

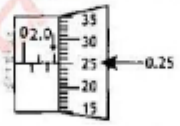
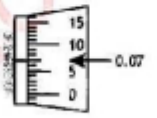
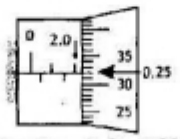
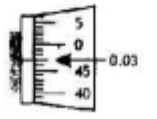
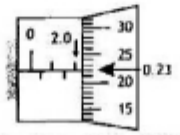



**Step 3**

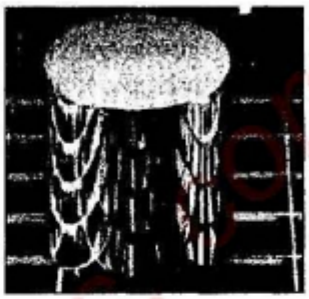
Take the thimble scale reading opposite the datum line of the main scale Multiply this reading with least count i.e., 0.01mm

**Step 4**

Now add main scale reading to thimble reading. This will be the diameter of the object.

| CHECKING FOR ZERO ERROR | OBSERVING READING | CORRECTED READING |
|---|---|---|
|  Zero mark on thimble scale coincides with the datum line on the main scale and reading on the main scale is zero. No zero error. |  Reading = 2.0 + 0.25 = 2.25mm | 2.25mm No zero error No Correction is required |
|  Zero on datum line can be seen. Positive Zero Error Reading = +0.07 mm (Count from Zero.) |  Reading = 2.0 + 0.32 = 2.32mm | 2.32-(+0.07) =2.25mm |
|  Zero mark on datum line cannot be seen negative zero error Reading = -0.03 mm (count down from 0) |  Reading = 2.0 + 0.23 = 2.23mm | 2.23 - (-0.03) =2.26mm |

**Q.14 What do you understand by the term "the standard mass"?**



*Ans:* ***The Standard of Mass:*** The kilogram is the S.I unit of mass and is equal to the mass of the international prototype of the kilogram, a platinum-iridium standard that is kept at the International Bureau of Weights and Measures.

A kilogram is a cylinder of special metal about 39 millimeters wide by 39 millimeters tall that serves as the world's mass standard.

Each country that subscribed to the International Metric Convention was assigned one or more copies of the international standards' these are known as National Prototype Meter and Kilogram.

**More Information:**

The kilogram, originally defined as:
The mass of one cubic decimeter of water at the temperature of maximum density. It was replaced after the International Metric Convention in 1875 by the International Prototype Kilogram.

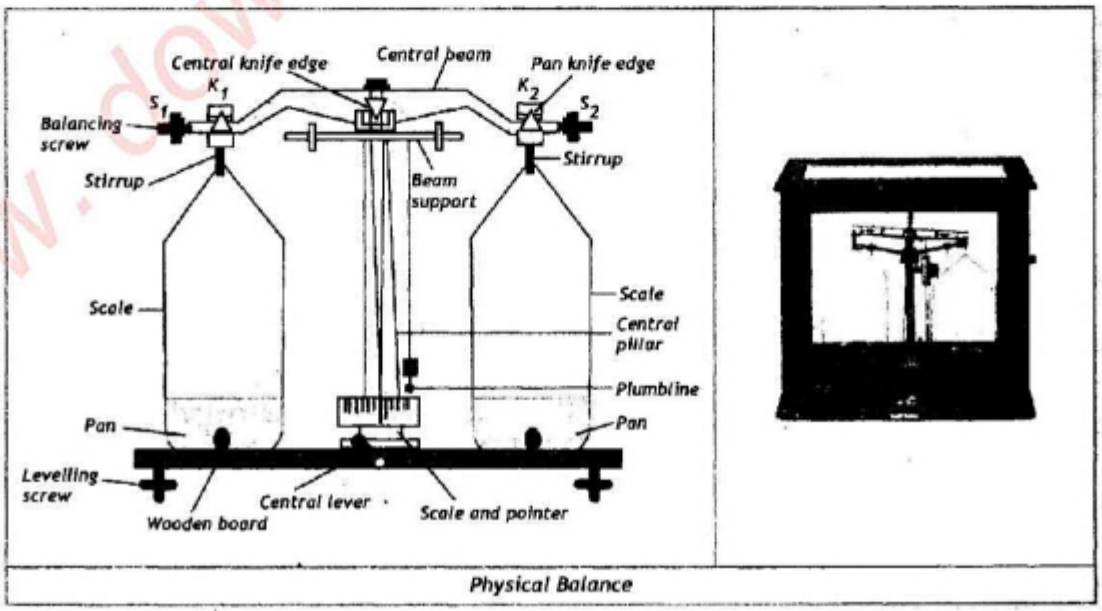
**Q.15 What is a physical balance? How does it work?**

*Ans:* ***Physical Balance:*** Physical balance is an instrument used for the measurement of mass. It is mostly used in a laboratory. It works on the principle of moments. It consists of a light and rigid beam of brass, a metallic pillar, a wooden base, two pans, a metallic pointer and an ivory scale.

The plumb line indicates whether the balance is horizontal. In an ideal condition, the plumb line is aligned with the end of the knob fixed with the pillar when the beam is horizontal the pointer remains on zero mark on the ivory scale. The whole box has levelling screws at the bottom to set it to horizontal. The device is enclosed in a glass box to avoid wind effects.

**More Information:**

1000g = 1kg
1g = 1000mg
1g = 1000000μg
1g = 1000000000ng
1g = 0.022 lb



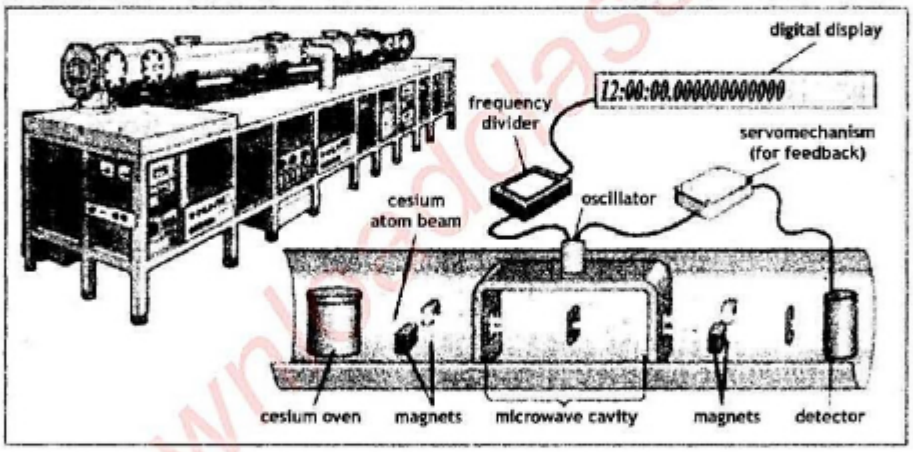

Physical Balance

**Q.16 What is an electronic balance?**

**Ans:** ***The Electronic Balance:*** The digital mass meter is an electronic instrument configured with integrated circuits and it works on the principle of balancing the forces.
The device is turned on and set to zero then the object is placed on the plate. The reading on the screen gives the mass of an object. The electronic balance is available in different ranges of measurement such as microgram, milligram and kilogram etc.

**Q.17 Describe the standard of time and define the second.**

**Ans:** ***The Standard of Time:*** Before 1960, the standard of time was defined in terms of the mean solar day for the year 1900. The rotation of the Earth is now known to vary slightly with time, this motion is not a good one to use for defining a time standard.
In 1960, the second was redefined to take advantage of the high precision attainable in a device known as an atomic clock, which uses the frequency of the caesium-133 atom as the "reference clock".
***Second:*** The second is now defined as 9129631770 times the period of vibration of radiation from the caesium atom.




**Q.18 What is a stopwatch? What is meant by "human reaction time"?**

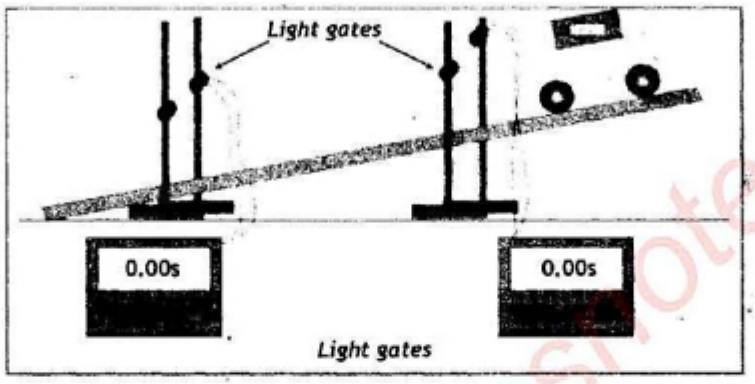
**Ans:** ***Stop Watch:*** A stopwatch is used to measure the time interval for two events. There are two types of stopwatch:
**(i)** Mechanical stopwatch, and **(ii)** Digital stopwatch

***Mechanical/Analogue Stopwatch:*** A mechanical stopwatch can measure a time interval up to 0.1 second. It has a knob that is used to wind the spring that powers the watch. It can also be used as a start-stop and reset button. The watch starts when the knob is pressed once. When pressed the second time, the watch stops while the third press brings the needle back to zero.

***Digital Stopwatch:*** A digital stopwatch can measure a time interval up to 0.01 second. It starts to indicate the time lapsed as the start/stop button is pressed. As soon as the start/stop button is pressed again, it stops and indicates the time interval recorded by it between the start and stop of an event. A reset button restores its initial zero settings. Nowadays almost all the mobile phones have a stopwatch function.

***Human Reaction Time:*** As analogue or digital or watch is operated by human manually i.e., they have to be started or stopped by hand. This causes a random error in the measurement of time i.e. called human reaction time. For most people, human reaction time is about 0.3-0.5 s. Therefore for more accurate measurement of time intervals light gates can be used.

**More Information:**
1 hour= 60 minutes
1 hour= 3600 seconds
1 min= 60 sec
1 sec= 1000 ms
1 sec= 1000000 µs




**Q.19 *What instrument will you choose to measure the height of your friend?***

*Ans:* To measure the height of our friend, we can use a meter rule or inch tape. When our height is measured at the doctor's clinic, we usually stand next to a device called a stadiometer.
A stadiometer is a long ruler attached to the wall. It has a sliding horizontal headpiece that's adjusted to rest on top of our head. It's a quick way of accurately measuring our height.

**Q.20 *Can you describe how many seconds are there in a year?***

*Ans:* One calendar common year has 365 days:
1 common year = 365 days = (365 days) × (24 hours/day) × (3600 seconds/hour) = 31536000 seconds

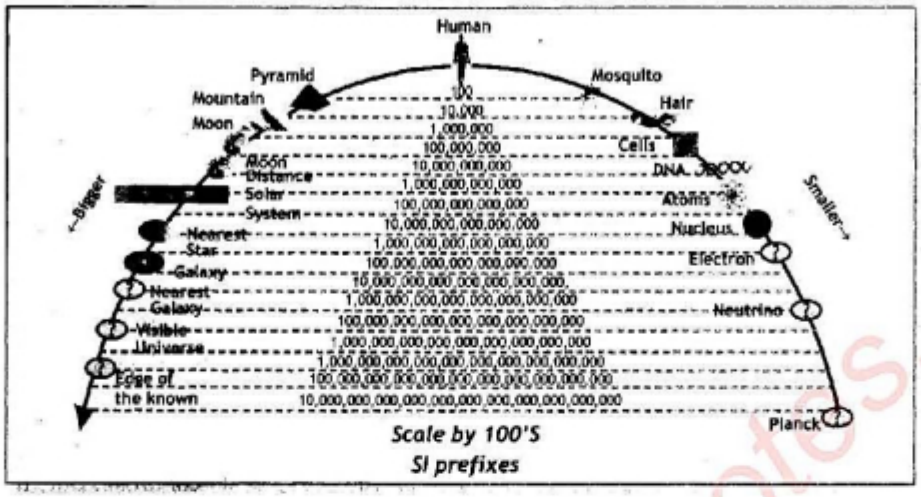
**Q.21 *Which instrument will you choose to measure your mass?***

*Ans:* The scientific word for how much an object weighs on a scale is "mass". Here we can use the words "weight" and "mass" interchangeably because both are used in everyday language. For example "I weigh 70 kg." or "the car's mass is 1 tonne".
Bathroom scales are used to measure a person's weight. They can be analogue or digital. Bathroom scales usually show units in kilograms and grams.

**Q.22 *Why prefixes are used for expressing units?***

*Ans:* ***Prefixes:*** The physical quantities are described by the scientist in terms of magnitudes and units. Units play a vital role in expressing a quantity either base or derived. Prefixes are useful for expressing units of physical quantities that are either very big or very small.
A unit prefix is a specifier. It indicates multiples or fractions of the units.
Units of various sizes are commonly formed by such prefixes. The prefixes of the metric system, such as kilo and millimeters, represent multiplication by a power of ten. Historically, many prefixes have been used or proposed by various sources, but only a narrow set has been recognized by standards organizations.

# PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)




*SI prefixes*

| *Prefix* | *Symbol* | *Meaning* | *Multiplier (Numerical)* | *Multiplier (Exponential)* |
|---|---|---|---|---|
| | | | ***Greater than 1*** | |
| tera | T | trillion | 1 000 000 000 000 | $10^{12}$ |
| giga | G | billion | 1 000 000 000 | $10^{9}$ |
| mega | M | million | 1 000 000 | $10^{6}$ |
| kilo | k | thousand | 1 000 | $10^{3}$ |
| hecto | h | hundred | 100 | $10^{2}$ |
| deka | da | ten | 10 | $10^{1}$ |
| | | | ***Less than 1*** | |
| **Unit** | **1** | | | |
| *deci | d | tenth | 0.1 | $10^{-1}$ |
| *centi | c | hundredth | 0.01 | $10^{-2}$ |
| *milli | m | thousandth | 0.001 | $10^{-3}$ |
| *micro | μ | millionth | 0.000 001 | $10^{-6}$ |
| *nano | n | billionth | 0.000 000 001 | $10^{-9}$ |
| pico | P | trillionth | 0.000 000 000 001 | $10^{-12}$ |
| femto | f | quadrillionth | 0.000 000 000 000 001 | $10^{-15}$ |
| atto | a | quintillionth | 0.000 000 000 000 000 001 | $10^{-18}$ |

**Q.23** ***Can you tell if the size of a nucleus is up to $10^{-15}$m, what prefix shall we use to describe its size?***

***Ans:*** femtometer fm $10^{-15}$m

**Q.24** ***Describe scientific notation.***

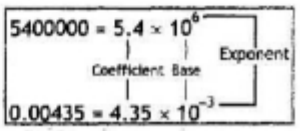
***Ans:*** ***Scientific Notation:*** Scientific notation or the standard form is a simple method of writing very larger numbers or very small numbers. In this method, numbers are written as powers of ten. Thus the calculation of very large or very small numbers become easy.

Numbers in Scientific Notation are made up of three parts:

*(i)* *The Coefficient:* The coefficient must be equal to or (not zero) greater than one.

*(ii)* *The Base:* The base must be 10

*(iii)* *The Exponent:* The exponent can be negative or positive.



**Quick Lab**

- Fill a tub with water to a certain level and mark.
- Put some ice in it and observe the water level carefully as well as floating or sinking.
- Remove the ice from the tub without being melt and put a balloon in it and then observe.
- Likewise, put a spoon in that tub and observe.
- Again put an empty can of coke and observe.
- Can you tell which of all four has more density? And which has more volume?

**Q.25** ***Why are physicists concerned about the property of matter which may help to define the nature of the matter in terms of its mass and space?***

*Ans:* The three common phases or states of matter are solid, liquid and gas. A solid maintains a fixed shape and a fixed size, even if the same force is applied it does not readily change its volume. A liquid does not maintain a fixed shape it takes on the shape of its container. But, like a solid, it is not readily compressible, and its volume can be changed significantly only by a large force. However, gas has neither a fixed shape nor a fixed volume-it will expand to fill its container.
Often we find the large weight woods floating on the surface to water. However, an iron needle sinks into the water. We say iron is "heavier" than wood. This cannot really be true rather we should say like iron is "denser" than wood. Physicists are concerned with a physical quantity, a property of matter which may help to define the nature of the matter in terms of its mass and space.

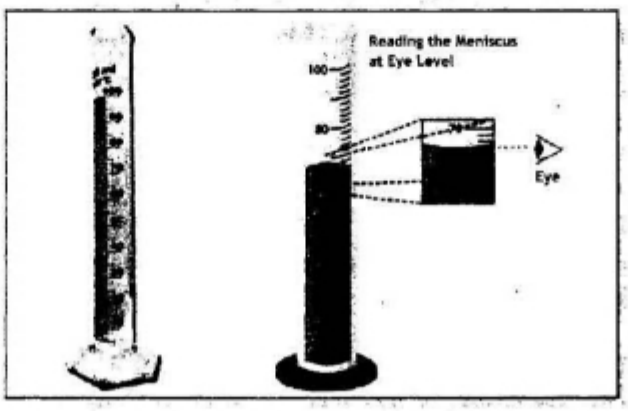
**Q.26** ***How can we measure the volume of solids, liquids and gases?***

*Ans:* ***Measuring the Volume:*** For density to be measured or calculated we first need to find the volume of substances. Most solid shapes have formulae for their volume which is obtained through different parameters such as radius, height, depth, width, base and length, but for irregular objects, liquids and gases this approach is unusual. The volume of liquids can be measured with the help of cylinders, and beakers.

**More Information:**
1 liter = 100 $cm^3$
1 $m^3$ = 1000 litre

**Q.27** ***How can we use a measuring cylinder to measure the volume of liquids?***

*Ans:* ***Measuring Cylinder:*** Measuring cylinder is a glass or plastic cylinder with a scale-graduated in cubic centimeters or milliliters (ml). It is used to find the volume of liquids. When a liquid is poured, it rises to a certain height in the cylinder. The level of liquid in the cylinder is noted and the volume of the liquid is obtained. To read the volume correctly we should keep the eye level with the bottom of the meniscus of the liquid surface.



***The Volume of Liquid:*** A volume of about a liter or so can be measured using a measuring cylinder. When the liquid is poured into the cylinder the level on the scale gives the volume. Most measuring cylinders have scales marked in milliliters (ml) or cubic centimeters ($cm^3$). It should be noted that while recording the value from the cylinder the eyes should maintain the level with the value. Angular observation may result in a false reading of the volume.

## Q.28 How can we measure the volume of a regular and irregular solid?

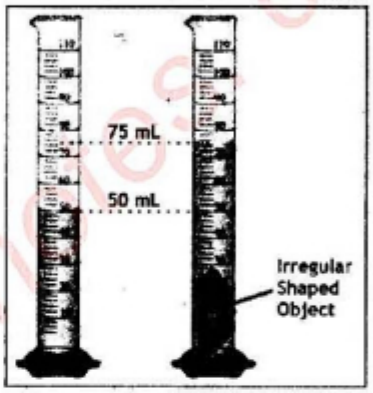
**Ans:** ***Regular Solid:*** If an object has a regular shape its volume can be calculated. For instance:

Volume of rectangular block = length x width × height

Volume of a cylinder = $\pi \times \text{radius}^2 \times \text{height}$

***Irregular Solid:*** For an irregular solid its volume is calculated by lowering the object in a partially filled measuring cylinder. The rise in the level on the volume scale gives the volume of that object. Thus the volume of irregular solid is calculated by subtracting the original volume of liquid from the raised volume of liquid.

The total volume is found. The volume of the solid is measured in a separate experiment and then subtracted from the total volume.




**Quick Lab**

- Take a measuring cylinder of 1 liter capacity at the full place it in a beaker.
- Fill cylinder full with water.
- Pour a stone of irregular shape in it gradually.
- As you pour the stone into the cylinder, the water from the cylinder drops into the beaker.
- Drop the stone in the cylinder completely.
- Calculate the volume of water ejected out of the cylinder.
- The volume of water ejected is the volume of the stone.

**More Information:**

During the Cold War between Russia and America. There was a race of Astrophysics. America was facing a period of racism. A Black lady mathematician named Katherine solved the problem of putting the first orbital satellite.
Recommended!
Watch the movie "Hidden Figures" Observe the importance of Reliable Numbers.

## Q.29 Define density. How can we measure density?

**Ans:** ***Density:*** The term density of a substance is defined as the mass of substance (m) per unit volume (V). It is denoted by the Greek letter ρ (rho).

$$\rho = \frac{m}{V}$$

Density is a characteristic property of any pure substance. Objects made of a particular pure substance such as pure gold can have any size or mass but its density will be the same for each. Following the above equation mass of a substance can be expressed as:

$$m = \rho V$$

***S.I. Unit of Density:*** The S.I unit for density is $kg/m^3$ ($kgm^{-3}$). Sometimes dens of substances are given in $gm/cm^3$. The density of Aluminum is 2.70 $gm/cm^3$ which is equal to 2700$Kg/m^3$.

***Measuring the Density:*** It is to be noted that there are two ways of finding the density of a substance either mathematically or experimentally by taking the density of water at 4°C as a reference which is sometimes known as relative density or 'specific gravity'. It has no unit, it is a number whose value is the same as that of the density in g/cm³.

$$\text{realtive density} = \frac{\text{density of substance}}{\text{density of water}}$$

**More Information:**
In Jordan, there is a sea known as the 'Dead Sea'.
The human in that sea while swimming does not sink!
This is because the water of the sea is much more salty than normal, which raises the density of water.

**Q.30 *Can you tell haw a hot air balloon works?***

***Ans:*** As air is heated, it becomes less dense than the surrounding cooler air. The less-dense hot air has enough lifting power to cause the balloon to float and rise into the air.

**Q.31 *Define and describe significant figures.***

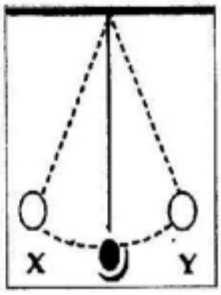
***Ans:*** ***Significant Figures:*** Engineers and scientists around the world work with numbers either representing a large or small magnitude of a physical quantity. The engineers are however interested in the accuracy of a value as they mostly work on estimation but scientists especially physicists are more concerned with the accuracy of these numbers. For instance, an engineer records the speed of the wind and explains it as an average. On the other hand, for the physicist, the speed of earth on its course, the speed of light in vacuum, the mass or charge on an electron is just not a matter of numbers but accurate numbers.
***Definition:*** The numbers of reliably known digits in a value are known as significant figures.

*Rules for determining significant figures*

| | Rule | Example |
|---|---|---|
| 1. | All non-zeros are significant. | 2.25 (3 significant figures) |
| 2. | Leading zeros are NOT significant. | 0.00000034 (2 significant figures) |
| 3. | Trailing zeros are significant ONLY if an explicit decimal point is present. | 200 (1 significant figures)<br>2000 (3 significant figures)<br>2.00 (3 significant figures) |
| 4. | Trapped zeros are significant. | 0.00509 (3 significant figures)<br>2045 (4 significant figures) |

**Q.32 *A pendulum swings as shown in the given figure from X to Y and back to X again.***
***(i) What would be the most accurate way of measuring time for one oscillation with the help of a stopwatch?***
***(a) Record time for 10 oscillations and multiply by 10***
***(b) Record time for 10 oscillations and divide by 10***
***(c) Record time for one oscillation (d) Record time for X to Y and double it***
***(ii) Suggest an instrument for measuring time period more accurately.***

***Ans:*** (i) A simple way to measure the pendulum's period fairly precisely is to start the pendulum swinging and measure the time required for a large number of FULL swings - 40, 50, or so. Choose the number of swings so that the total time for the measurement is 40 seconds or more. Dividing the total time by the number of full swings will give the period.
(a) to (d) For these questions, we need readings so you have to perform practical work to answer them.




(ii) Today, the usual measuring instruments for time are clocks and watches. For a highly accurate measurement of time, an atomic clock is used. For more accurate measurement of time intervals, light gates can be used.

# PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

## Section D — Numerical

### Worked Examples of the Textbook

**01.** ***Convert mass of Sun 2 000 000 000 000 000 000 000 000 000 000 kg into scientific notation.***

***Solution:***

*Step 1:* Since, $M_{sun}$ = 2 000 000 000 000 000 000 000 000 000 000 kg
It's obvious that in this value decimal lies at the end.

*Step 2:* Converting into scientific notation
Move the decimal to left writing in terms of base of ten $M_{sun} = 200 \times 10^{30}$ kg

*Note:* Power of exponent is taken as positive not to be confused as we have displaced decimals but not numbers.

**02.** ***Convert the mass of electron $9.11 \times 10^{-31}$ kg into standard form.***

***Solution:***

*Step 1:* The decimal lies in the middle of the value.
Since, $m_{electron} = 9.11 \times 10^{-31}$ kg

*Step 2:* Move the decimal 31 steps towards left
$m_{electron}$ = 0.000 000 000 000 000 000 000 000 000 000 911 kg

**03.** ***What is the mass of a solid iron wrecking ball of radius 18cm, if the density of iron is 7.8 gm/cm³?***

***Solution:***

*Step 1:* Write known physical quantities with units and point out the quantity to be found.
Density of iron ball $\rho = 7.8$ gm/cm³ $= 7.8 \times 1000$ kg/m³
Radius of iron ball is $r = 18$ cm $= 18 \times 10^{-2}$ m $= 0.18$ m
Volume of the iron ball is $V = (4/3) \times \pi \times r^3 = (1.33) \times 3.14 \times (0.18\text{m})^3$
$V = 0.024$ m³

*Step 2:* Write down the formula and rearrange if necessary.
$m = \rho \times V$

*Step 3:* Put the values in formula and calculate
Since mass of iron ball is $m = \rho \times V = (7.8 \times 10^3) \times (0.024)$
$m = 187.2$ Kg

**04.** ***How many significant figures are there in the area of a cylinder whose diameter is 5 cm?***

***Solution:***

*Step 1:* Write known physical quantities and point out the unknown quantity
Diameter of the cylinder is $d = 5\text{cm} = 5 \times 10^{-2}$ m $= 0.05$ m
Radius of cylinder is $r = d/2 = 2.5 \times 10^{-2}$ m $= 0.025$ m

*Step 2:* Write down formula and rearrange if necessary
The area of the cylinder is $A = \pi \times r^2 = 3.14 \times (0.025\text{m})^2 = 0.019$ m²

*Step 3:* Put value in formula and calculate:
Thus the area of the cylinder can be written as $A = 1.9$ mm²
Thus, there are two significant numbers in the value 1 and 9.

## Solved Numerical

**01.** *Convert the following values:*

(a) 230cm = _____ m (b) 250g = _____ kg
(c) 0.5s = _____ ms (d) 0.8m = _____ mm
(e) 350ms = _____ s (f) 1.2Kg = _____ g

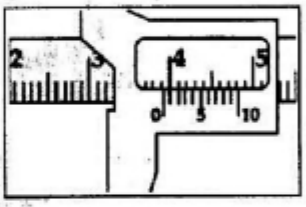
*Ans:* (a) 2.3 m (b) 0.25 kg (c) 5000 ms (d) 800 mm
(e) 0.35 s (f) 1200 gm

**02.** *An engineer measures the width of an aluminium sheet using a Vernier caliper as shown in the given figure.*

(a) What is the measurement of the width of an aluminium sheet?
(b) Which gives more precise measurement Vernier caliper, Screw Gauge or meter rule?

**Solution:** (a) Main Scale Reading = 3.9 mm
Vernier Scale Reading = 0.1 mm

Total Reading = 4.0 $mm^3$ Ans.




(b) As compare to Vernier calipers and meter rule, screw gauge is more precise because the least count of Vernier calipers is 0.1 mm, least count of meter rule is 1mm and for screw gauge, it is 0.01 mm. So, a screw gauge can measure more precisely than a Vernier caliper and meter rule.

**03.** *Write the correct prefix of notion:*

(a) 75000m = 750_____ (b) 2/1000sec = 1 _____
(c) 1/1000000 g = 1_____ (d) 1000000000m = 1_____

*Solution:*

(a) $750 \times 10^2$ m hecto (b) $2 \times 10^{-3}$ sec milli
(c) $1 \times 10^{-6}$ g micro (d) $1 \times 10^9$ m giga

**04.** *Write values in standard and scientific notation*

(a) The radius of 1st orbit of Hydrogen atom is r = 0.53A° = _____
(b) 1 light year is 2628000000000 m = _____
(c) Vacuum pressure $2.7 \times 10^{-4}$ torr = _____

*Ans:*

| | | Standard Notation | Scientific Notation |
|---|---|---|---|
| (a) | 0.53A° | 53 pm | $53 \times 10^{-12}$ m |
| (b) | 2628000000000 m | 2.628 pm | $2.628 \times 10^{12}$ m |
| (c) | $2.7 \times 10^{-4}$ torr | 0.00027 torr | $2.7 \times 10^{-4}$ torr |

**05.** *A wooden piece is made in different shapes take length (l) = radius (r) = 2m. Calculate its volume as a:*

(a) Sphere (b) Cube (c) Cylinder (d) Pyramid

*Solution:* (a) A sphere of radius r = 2 m

*Calculation:* Formula for the volume of a sphere is

$$V = \frac{4}{3}\pi r^3$$

$$V = \frac{4}{3}(3.14)(2)^3 = \frac{4}{3}(3.14)(8) = \frac{100.48}{3} = 33.49\ m^3 \quad \text{Ans.}$$

(b) A cube of length $\ell = 2$ m

*Calculation:* Formula for the volume of a cube is

$V = \text{Length} \times \text{Width} \times \text{Height} = \ell \times \ell \times \ell = \ell^3$

$V = 2 \times 2 \times 2 = 8\ m^3$ Ans.

(c) A cylinder of height h = 2 m and base radius r = 2 m

*Calculation:* Formula for the volume of a cylinder is

$V = \pi r^2 h$

$V = (3.14)(2)^2(2) = (3.14)(4)(2) = (3.14)(8) = 25.12\ m^3$ Ans.

(d) A pyramid of height h = 2 m and base edge l = 2 m

*Calculation:* Formula for the volume of a pyramid is

$$V = \frac{1}{3}\ell^2 h$$

$$V = \frac{1}{3}(2)^2(2) = \frac{1}{3}(4)(2) = \frac{1}{3}(8) = 2.66\ m^3$$ Ans.

**06.** ***Find the density of wood as sphere and cube if the mass of wood is 1kg. Is there any change in density due to shape?***

***Solution:*** *Data:* mass of wood = m = 1 kg

Volume of wood as sphere = V = 33.49 $m^3$ (calculated in Q 5(a))

Density of wood as sphere = ρ = ?

*Calculation:* Formula $\rho = \frac{m}{V}$

$$\rho = \frac{1}{33.49} = 0.029\ kg/m^3$$ Ans.

*Data:* mass of wood = m = 1 kg

Volume of wood as cube = V = 8 $m^3$ (calculated in Q 5(b))

Density of wood as cube = ρ = ?

*Calculation:* Formula $\rho = \frac{m}{V}$

$$\rho = \frac{1}{8} = 0.125\ kg/m^3$$ Ans.

**07.** ***Write significant numbers in the following values:***

***(a) 980 has _____ significant numbers.***

***(b) 91.60 has _____ significant numbers.***

***(c) 10010.100 has _____ significant numbers.***

***(d) 0.086 has _____ significant numbers.***

*Ans:* (a) 2 (b) 4 (c) 8 (d) 2

**08.** ***Determine the number of significant figures in 00.6022009.***

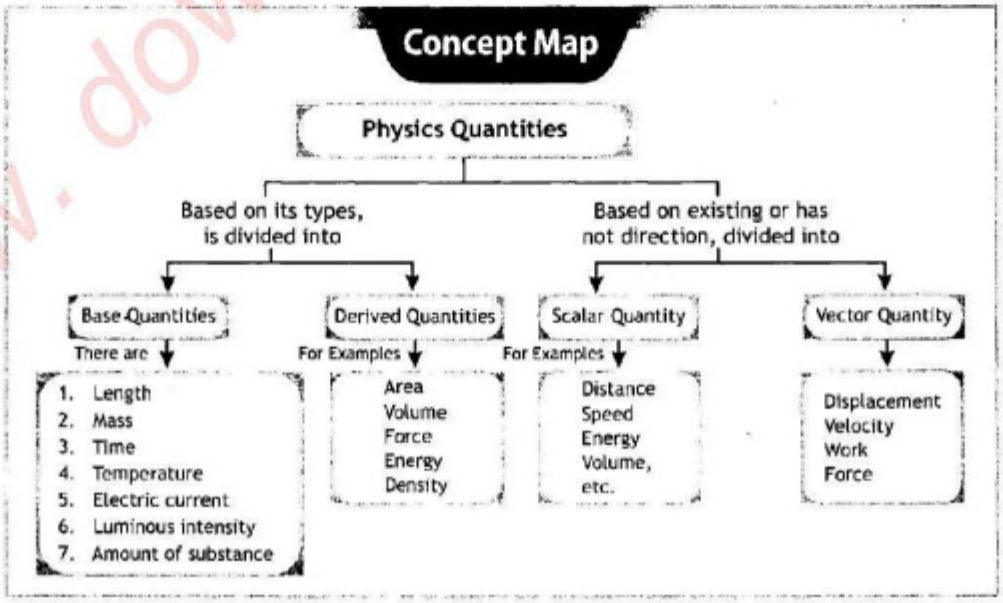
***Solution:*** No. of significant figures: 7

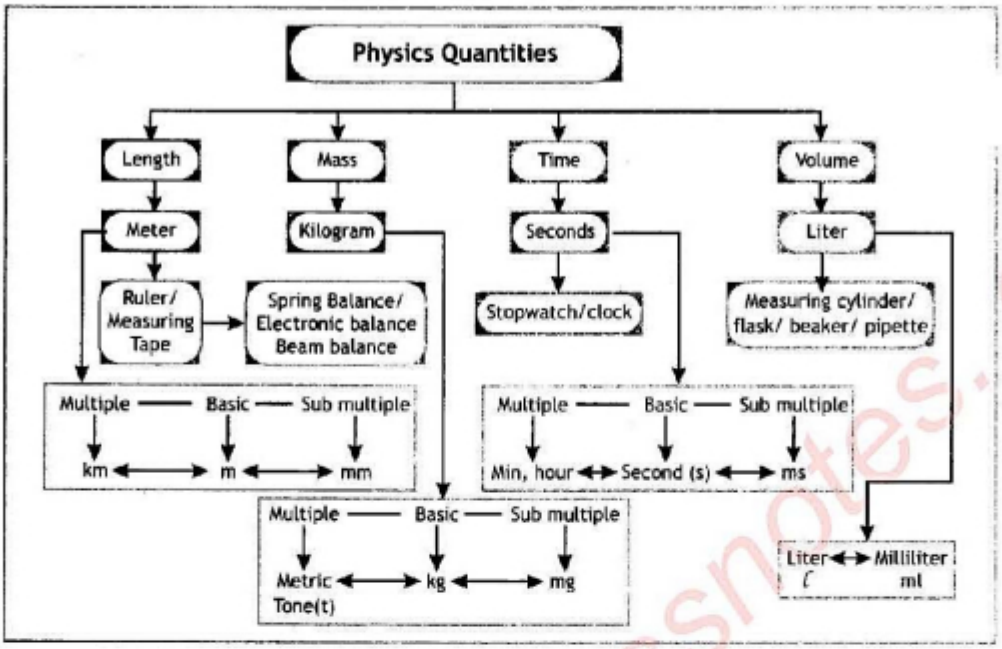
No. of decimals: 7 Scientific notation: $6.022009 \times 10^{-1}$

## Summary

- Physics is the branch of science which deals with studies of matter its composition, properties, and interaction with energy.
- The branches of Physics are classified on the basis of different areas of study with different approaches.
- There are two types of physicists, theoretical and experimental physicists.
- Physics define mathematical relation between physical quantities. A physical quantity has magnitude and unit.
- A physical quantity is mainly classified into two categories:
  (i) Base or Fundamental quantities (ii) Derived physical quantities.
- Base quantities are length, mass, time, temperature, current, luminous intensity, and amount of substance.
- The standard of length is meter can be measured by measuring tape, or meter rule.
- The standard of mass is kilogram can be measured by physical balance.
- The standard of time is second can be measured by stopwatch.
- The measured or calculated values either macroscopic or microscopic can be expressed in scientific notations.
- The volume of liquid is calculated or measured with help of a measuring cylinder.
- The volume of irregular objects can be calculated by measuring the cylinder with the displacement of water.
- The density of a pure substance is its characteristics property. It is the ratio of mass per unit volume.
- The density of objects can be calculated with the help of water as a reference known as specific gravity also known as relative density.
- Prefixes can be used to represent large or smaller values of a physical quantity.
- The most accurate or reliable numbers of a value are known as significant figures.

## Concept Map






# End of Unit Questions Solution

***SECTION – A: MULTIPLE CHOICE QUESTIONS***

***Tick Mark (✓) the correct answer:***

See "Multiple Choice Questions (M.C.Qs)" – (1) to (10)

***SECTION – B: STRUCTURED QUESTIONS***

**01.**

| *Column A – Action* | *Column B – Branch* |
|---|---|
| Cooking Bar B.Q | Thermodynamic |
| Turning the Bulb on | Electricity |
| Riding a bicycle | Mechanics |
| Looking for Giant Galaxies | Astrophysics |
| Producing a loud sound | Sound |
| Describing an atom | Atomic Physics |
| Obtaining energy from Earth | Geo Physics |

**02.**

| *Physical Quantity* | *S.I Unit* | *Type* |
|---|---|---|
| Ampere | A | Base |
| Volume | $m^3$ | Derived |
| Time | Sec | Base |
| Temperature | K | Base |
| Force | N | Derived |
| Density | kg per $m^3$ | Derived |
| Acceleration | $m/s^2$ | Derived |

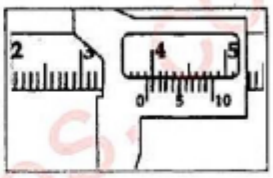
## PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

**03.** *Convert the following values:*

*(a)* 230cm = _____ m  *(b)* 250g = _____ kg
*(c)* 0.5s = _____ ms  *(d)* 0.8m = _____ mm
*(e)* 350ms = _____ s  *(f)* 1.2Kg = _____ g

*Ans:* See "Solved Numerical" – Q.1

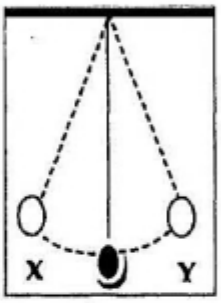
**04.** *An engineer measures the width of an aluminium sheet using a Vernier caliper as shown in the given figure.*



*(a)* *What is the measurement of the width of an aluminium sheet?*
*(b)* *Which gives more precise measurement Vernier caliper, Screw Gauge or meter rule?*

*Ans:* See "Solved Numerical" – Q.2

**05.** *A pendulum swings as shown in the given figure from X to Y and back to X again.*




*(i)* *What would be the most accurate way of measuring time for one oscillation with the help of a stopwatch?*
  *(a)* *Record time for 10 oscillations and multiply by 10*
  *(b)* *Record time for 10 oscillations and divide by 10*
  *(c)* *Record time for one oscillation*
  *(d)* *Record time for X to Y and double it*
*(ii)* *Suggest an instrument for measuring time period more accurately.*

*Ans:* See "Short & Detailed Answer Questions" – Q.32

*Prefixes*

**06.** *Write the correct prefix of notion:*

*(a)* 75000m = 750_____  *(b)* 2/1000sec = 1 _____
*(c)* 1/1000000 g = 1_____  *(d)* 1000000000m = 1_____

*Ans:* See "Solved Numerical" – Q.3

*Scientific Notation*

**07.** *Write values in standard and scientific notation*

*(a)* The radius of 1st orbit of Hydrogen atom is r = 0.53A° = _____
*(b)* 1 light year is 2628000000000 m = _____
*(c)* Vacuum pressure $2.7 \times 10^{-4}$ torr = _____

*Ans:* See "Solved Numerical" – Q.4

*Density and Volume*

**08.** *A wooden piece is made in different shapes take length (ℓ) = radius (r) = 2m. Calculate its volume as a:*

*(a)* Sphere  *(b)* Cube  *(c)* Cylinder  *(d)* Pyramid

*Ans:* See "Solved Numerical" – Q.5

**09.** *Find the density of wood as sphere and cube if the mass of wood is 1kg. Is there any change in density due to shape?*

*Ans:* See "Solved Numerical" – Q.6

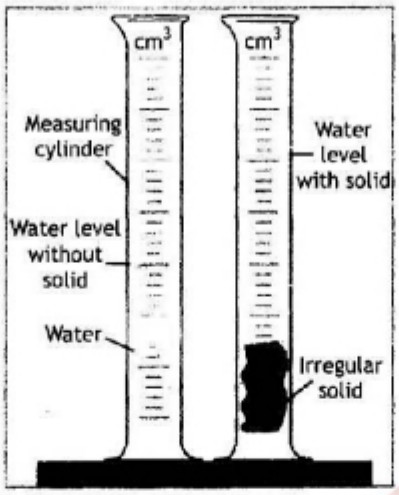
**10.** *A measuring cylinder (in the given figure) is filled with 500cc water. A stone of mass 20g is immersed into the cylinder such that the water level rises to 800cc. Which statement is correct?*

*(a)* The difference between the readings gives the density of the stone.
*(b)* The difference between the readings gives the volume of the stone.

*(c) The final reading gives the density of stone*

*(d) The final reading gives the volume of stone*

***Ans:*** **(b)** The difference between the readings gives the volume of the stone




***Significant Figures***

**11** ***Write significant numbers in the following values:***

***(a) 980 has _____ significant numbers.***

***(b) 91.60 has _____ significant numbers.***

***(c) 10010.100 has _____ significant numbers.***

***(d) 0.086 has _____ significant numbers.***

***Ans:*** See "Solved Numerical" – Q.7