Q.1  What is physics? Describe its main branches.

Ans.  Physics

The branch of science which deals with the study of properties of matter, energy and their mutual relationship is called physics.

Main branches of physics are;

(1)  Mechanics
The branch of physics that deals with the study of motion of material objects under the action of forces.

(2)  Heat and Thermodynamics
The branch of physics which deals with the transformation of heat energy into other forms of energy.

(3)  Optics
The branch of physics which deals with the nature of light, its propagation, reflection, refraction, dispersion and the wave properties of light.

(4)  Electricity and magnetism
It deals with the study of static as well as moving charges and the phenomena that occurs due to the effects of charges.

(5)  Atomic physics
The branch of physics which deals with the structure and properties of individual atoms.

Q.2  What is physical quantity? Describe its types.

Ans.  Physical quantity

A quantity which can be easily observed and measured is called physical quantity. For example

Distance, mass, time, Area, Volume, etc.

There are two types of physical quantities;

(1)  Base physical quantities
Those physical quantities which are the simplest standards selected by the scientists for other quantities are called base or standard physical quantities. For examples
Length, mass, time, electric current, temperature, etc.

(2)  Derived physical quantities
Those physical quantities which are obtained by multiplying or dividing the base physical quantities are called derived physical quantities. For examples
Force, Area, Volume, speed, acceleration etc.
Q.3  **What is international system of units?**
**Ans.** The set of units used for the physical quantities are called system of units. The system of units in which the unit of length, mass and time is meter, kilogram and second respectively is called system international (SI). It is based on seven basic units from which all other units are derived.

Q.4  **What are prefixes? Explain**
**Ans.** *Prefixes*
In scientific calculation some time we have to deal with quantities that are either very large or small compared with the base units, in such cases we use higher or smaller units of the standard unit. These smaller or higher units are in power of 10 which are called prefixes. For examples:
The distance between two cities is taken in kilometer rather than in meter.
The thickness of a wire is taken in millimeter rather than in meter.

**Table of prefixes**

<table>
<thead>
<tr>
<th>Sub Multiples</th>
<th>prefix</th>
<th>symbol</th>
<th>Multiples</th>
<th>prefix</th>
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<td>atto</td>
<td>a</td>
<td>$10^{18}$</td>
<td>exa</td>
<td>E</td>
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</tbody>
</table>

Q.5  **State and explain what is scientific notation?**
**Ans.** *Scientific Notation*
Every small or large number "N" can be expressed in terms of number "M" multiplied by the negative or positive power of 10 as follow:
\[ N = M \times 10^n \]
Where \( n = 0, \pm 1, \pm 2, \pm 3, \pm 4, \ldots \ldots \ldots \)
It must be noted that the first digit of "M" from left to the right is non zero digit.
➢ In a given number N, move the decimal point and place it after the first non zero digit.
➢ If the decimal point is moved towards left from its given initial position, then the power of 10 will be positive.
➢ Similarly if the decimal point is moved towards right from its given initial position, then the power of 10 will be negative. For examples:
The mass of moon is 7,000,000,000,000,000,000,000Kg.
In scientific Notation
\[ = 7 \times 10^{22}\text{Kg}. \]
The diameter of atomic nucleus is about \(0.00000000000001\) m. In scientific notation:
\[1 \times 10^{-14}\] m.

Q.6 What is meant by significant figures? How it can be identified.
Ans. Significant figures
It can be defined as “The number of accurately known figures and the first doubtful figure are known as significant figures. For example
\[9.8, 9.7, 9.94, 9.85\] have two significant figures.

Rules for determination of significant figures are:
(1) All the non zero digits are significant. For example \(126.3\) have four significant figures.
(2) Zero between two non zero digits is significant. For example \(1.302\) have four significant figures.
(3) Zero after decimal having non zero digit at the end is non significant. For examples \(1.021\) and \(0.0046\) has three significant figures.
(4) Zero to the right of the decimal point is significant having no non zero digit at the end. For example \(22.00\) and \(25.40\) has four significant figures.

Q.7 Give points to advocate that physics is linked with Biology, Chemistry, Geography and Astronomy?
Ans. Physics is the root of every science. Its major developments are in Chemistry, Biology, Geology, Agriculture, Environmental science, Astronomy, Engineering and in Medicine. It also laid the foundation of modern science. Physics approves our quality of life by providing new instruments for medical applications such as computer tomography (CT scan), magnetic resonance imaging (MRI), ultrasonic imaging and laser surgery.

Q.8 Write a comprehensive note on Vernier calipers?
Ans. Vernier calipers
An instrument used to measure small length up to \(0.1\) mm \((0.01\) cm). It was invented by a French mathematician Pierre Vernier in 1631.
Construction
It consists of two scale i.e. main scale and Vernier scale.

(1) Main scale
It has marking of 1 mm each and contains a jaw on its left end.

(2) Vernier scale
A sliding scale that has marking of \(0.9\) mm each. It has total 10 or 20 divisions. Vernier scale also contains a jaw on its left end.
Least count
The smallest digit on the main scale divided by the total numbers on the Vernier scale is called least count of Vernier calipers. It is denoted by "L.C". Mathematically

\[ L.C = \frac{1mm}{10} = 0.1mm \text{ or } 0.01cm \]

Working
Consider we want to measure the diameter of a small solid cylinder;
- First note the least count of Vernier calipers.
- Close the jaws of the Vernier calipers and check the zero error.
- Fix the solid cylinder in between the jaws of the Vernier calipers and tighten the screw.
- Note the reading on the Main scale (MSR).
- Find out the coincide division of the Vernier with the Main scale.
- Multiply the coincide division with the least count; this is called Vernier scale reading (VSR).
- Add MSR with VSR, this is the required diameter of the solid cylinder.

Q.9 What is zero error in Vernier calipers? How it can be corrected.
Ans. Zero Error
If the jaws of the Vernier calipers are closed and the zero of the main scale does not coincide with the zero of the Vernier scale, then there is an error in the Vernier calipers which are called zero error.
There are two types of zero error.
(1) **Positive zero error**
When the zero of the Vernier scale remains right to the zero of the main scale, the error is called positive zero error. The positive zero error must be subtracted from each reading.

(2) **Negative zero error**
When the zero of the Vernier scale remains left to the zero of the main scale, the error is called negative zero error. The negative zero error must be added with each reading.

**Q.10** Write a comprehensive note on Screw gauge?
**Ans.** Screw gauge
A micrometer screw gauge is used to measure small lengths or diameter up to 0.01mm or 0.001cm.

**Construction**
The construction of a screw gauge is shown in the figure below.

**Least count**
The pitch of the screw divided by the total number of divisions on the circular scale is called least count of the screw gauge. Mathematically

\[ L \cdot C = \frac{1mm}{100} = 0.01mm \quad \text{Or} \quad 0.001cm \]

**Working**
Consider we want to measure the diameter of a small sphere;  
- Note the least count of the screw gauge.  
- Check zero error in the screw gauge by closing it.  
- Place the sphere between the spindle and anvil and close it.
Note the reading on the main scale (MSR).

Find out the coincide digit of the circular scale with the main scale.

Multiply the coincide digit with the least count; this is called circular scale reading (CSR).

Add MSR and CSR, this is the required diameter of the sphere.

Q.11 What is zero error in screw gauge? How it can be corrected.

Ans. Zero error and its correction

If the spindle and anvil of the screw gauge are closed and the zero of the main scale does not coincide with the zero of circular scale, then there is an error in the screw gauge which is called zero error.

Negative zero error

If the zero mark of the circular scale remains above the datum line of the main scale, then the error is called negative zero error which is added with each reading.

Positive zero error

If the zero mark of the circular scale remains below the datum line of the main scale, then the error is called positive zero error which is subtracted from each reading.

Q.12 Write a note on measuring cylinder?

Ans. Measuring cylinder

The device use to measure the volume of a substance using a liquid is called measuring cylinder. It is made up from a transparent plastic or glass having a vertical scale in millimeter (ml) or in cubic centimeter (cm³). When a liquid is poured into the cylinder, the volume is read from the scale on the side. The surface of the liquid curves upward at the point where it touches the inside of the cylinder. This curvature is called the meniscus. To read the volume of a liquid accurately the base of the measuring cylinder must be placed on a flat surface and eye must be leveled with the bottom of the meniscus.
Conceptual Questions
1. Give some examples of applications of work done by physicists.
   Ans. Work done by some common physicists are as under.
   ➢ Alberuni determined the circumference of the earth.
   ➢ Bu Ali Sena introduce the laws of reflection of light.
   ➢ Yaqub kindi express musical nodes in terms of scientific method.
   ➢ Dr. Abdussalam proposed the grand unification theory in physics.
2. Name the convenient unit you will use to measure
   a. Width of a book   b. length of a room   c. diameter of a wire
   Ans. The most convenient unit of
   (a) Width of a book is centimeter.
   (b) Length of a room is meter.
   (c) Diameter of a wire is millimeter.
3. Name the most convenient unit of mass you will use to measure
   a. mass of a candy   b. bag of a sugar   c. mass of a cricket ball
   Ans. The most convenient unit of
   (a) mass of a candy is milligram (mg).
4. Name the seven SI base quantities and their units of measurement.

Ans. The seven basic quantities and their units are;

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of quantity</th>
<th>Symbol</th>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length</td>
<td>l</td>
<td>meter</td>
<td>m</td>
</tr>
<tr>
<td>2</td>
<td>Mass</td>
<td>m</td>
<td>Kilogram</td>
<td>Kg</td>
</tr>
<tr>
<td>3</td>
<td>Time</td>
<td>t</td>
<td>Second</td>
<td>S</td>
</tr>
<tr>
<td>4</td>
<td>Electric current</td>
<td>i</td>
<td>Ampere</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td>Temperature</td>
<td>T</td>
<td>Kelvin</td>
<td>K</td>
</tr>
<tr>
<td>6</td>
<td>Intensity of light</td>
<td>I</td>
<td>Candela</td>
<td>Cd</td>
</tr>
<tr>
<td>7</td>
<td>Amount of substance</td>
<td>n</td>
<td>Mole</td>
<td>mol</td>
</tr>
</tbody>
</table>

5. Choose the base physical quantities and derived physical quantities from the following.

Temperature, Volume, Time, Area, Density, Length

Ans. Base physical quantities
Temperature, Time, Length
Derived physical quantities
Volume, Area, Density

6. Why area is called a derived quantity?

Ans. Area is the multiplication of two base physical quantities length and width. Therefore it is known as derived physical quantity. Mathematically

\[ \text{Area} = \text{length} \times \text{width} \]

\[ A = L \times W \]

The SI unit of area is \( \text{m}^2 \).

7. Digital stopwatch is more commonly used in physics experiments. Why?

Ans. Stopwatch
A device used to measure a specific interval of time is called stopwatch. Digital stopwatch is more commonly used in physics experiments because it is more accurate than analogue stopwatch. Digital stopwatch can measure time up to \( 0 \cdot 01 \text{S} \) while the analogue stopwatch can measure time up to \( 0 \cdot 1 \text{S} \).
8. **Give the names and symbols of the prefixes used to represent the following values;**
   a. $10^{-3}$  
   b. $10^{-6}$  
   c. $10^{-9}$  
   d. $10^{-12}$

   **Ans.** The names and symbols of the above prefixes are:

<table>
<thead>
<tr>
<th>Prefixes</th>
<th>Names</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^{-3}$</td>
<td>milli</td>
<td>m</td>
</tr>
<tr>
<td>$10^{-6}$</td>
<td>micro</td>
<td>µ</td>
</tr>
<tr>
<td>$10^{-9}$</td>
<td>nano</td>
<td>n</td>
</tr>
<tr>
<td>$10^{-12}$</td>
<td>pico</td>
<td>p</td>
</tr>
</tbody>
</table>

9. **How much water in units of liter can fill a water tank of $1m^3$ capacity?**

   **Explain**

   **Ans.** We know that

   $1m = 100cm$

   So

   $(1m)^3 = (100cm)^3$

   $1m^3 = 1000000cm^3$

   We also know that

   $1000cm^3 = 1liter$

   $1m^3 = \frac{1000000}{1000} liters$

   $1m^3 = 1000 liters$

10. **Explain the statement “A micrometer screw gauge measures more accurately than Vernier calipers.”**

    **Ans.** A micrometer screw gauge can measure up to 0.01mm (0.001cm) and a Vernier calipers can measures up to 0.1mm (0.01cm). Therefore “A micrometer screw gauge measures more accurately than a Vernier calipers.”

11. **If the zero of circular scale is above the datum line then explains how we can correct our reading?**

    **Ans.** If the zero of circular scale is above the datum line then the error is called negative zero error. We can correct our reading by adding the error with the final value.

12. **How can we find the volume of a small pebble with the help of measuring cylinder?**

    **Ans.** To find the volume of a small pebble water is poured in measuring cylinder and noted the volume of water. Then put the pebble in the cylinder gently. When the pebble is completely immersed the volume of water is read
again. The volume of the pebble is found by subtracting the first reading from the second.

**Numerical Questions**

1. Express the following in terms of powers of 10.
   a) 7 nanometer  
   b) 96 megawatt  
   c) 2 gigabite  
   d) 43 Pico farad  
   e) 2 millimeter  
   
   **Solution**
   a) $7 \times 10^{-9}$ meter  
   b) $96 \times 10^6$ watt  
   c) $2 \times 10^9$ bites  
   d) $43 \times 10^{-12}$ farad  
   e) $2 \times 10^{-3}$ meter  

2. For each of these values, identify the number of significant figures and rewrite it in the standard scientific notation.
   a) $706.5 \text{g}$  
   b) $0.067800\text{s}$  
   
   **Solution**
   a) $706.5 \text{g}$  
   There are four significant figures in $706.5 \text{g}$.  
   $706.5 \text{g} = 7.065 \times 10^2 \text{g}$  
   b) $0.067800\text{s}$  
   There are five significant figures in $0.067800\text{s}$.  
   $0.067800\text{s} = 6.78 \times 10^{-2} \text{s}$  

3. Express the following in terms of scientific notation using power of 10.
   a) Diameter of HIV = $0.0000001\text{m}$  
   b) Diameter of the sun = $1000000000\text{m}$  
   
   **Solution**
   a) $0.0000001\text{m}$  
   $= 1 \times 10^{-7} \text{m}$  
   b) $1000000000\text{m}$  
   $= 1 \times 10^9 \text{m}$  

4. A beaker contains 200 ml of water (1 liter = 1000 cm$^3$), what is volume of water in cm$^3$ and m$^3$?
   
   **Given data**
   Volume = $V = 200\text{ml}$  
   1 liter = 1000 cm$^3$  
   
   **Solution**
   We know that  
   1 liter = 1000 ml  
   $1000 \text{ml} = 1000 \text{cm}^3$
1ml = 1cm³
Volume in cm³ is
V = 200ml
V = 200 (1cm³)
\[ V = 200 \text{ cm}^3 \] (Answer)
Volume in m³
V = 200cm³
V = 200 x (10⁻²m)³
V = 200 x 10⁻⁶m³
V = 2 x 10⁻⁴ m³
\[ V = 0 \cdot 0002 \text{ m}^3 \] (Answer)

5. An aquarium having dimensions of 0.4 m width, 70 cm length and 3 dm height is half filled with water. Find the volume of water in m³ and cm³?

**Given data**
- Width of aquarium = \( w = 0 \cdot 4 \text{ m} = 40\text{ cm} \)
- Length of aquarium = \( L = 70 \text{ cm} = 0 \cdot 7 \text{ m} \)
- Height of aquarium = \( h = 3 \text{ dm} = 30 \text{ cm} = 0 \cdot 3 \text{ m} \)

**Solution**

**Volume of aquarium in m³ is**
\[ V = L \text{ (m)} \times w \text{ (m)} \times h \text{ (m)} \]
\[ V = 0 \cdot 7m \times 0 \cdot 4m \times 0 \cdot 3m \]
\[ V = 0 \cdot 084m^3 \]

**Volume of water in aquarium in (m³) is**
\[ V = \frac{0 \cdot 084}{2} \]
\[ V = 0 \cdot 042m^3 \] OR \[ 4 \cdot 2 \times 10^{-2} m^3 \]

**Volume of aquarium in cm³ is**
\[ V = l(cm) \times w(cm) \times h(cm) \]
\[ V = 70cm \times 40cm \times 30cm \]
\[ V = 84000cm^3 \]

**Volume of water in aquarium in (cm³) is**
\[ V = \frac{84000}{2} \]
\[ V = 42000cm^3 \] OR \[ 4 \cdot 2 \times 10^4 cm^3 \]