THE SCOPE OF PHYSICS 1

SCIENCE

Science is the systematic study of all natural phenomena. It is based on observations, experiments and measurements.

BRANCHES OF SCIENCE:

The subject science has been divided into two main branches.

(i) Physical Sciences

(ii) Biological Sciences

PHYSICAL SCIENCES:

The Physical Science deals with the properties and behaviour of non-living things.

Physics, Chemistry, Astronomy, Geology e.t.c.

BIOLOGICAL SCIENCES:

The Biological science deals with living things.

Botany, Genetics, Zoology, Microbiology e.t.c.

PHYSICS:

The branch of Physical science which deals with the interaction of matter and energy is called Physics. Moreover it is based on experimental observations and quantitative measurements.

BRANCHES OF PHYSICS:

The main branches of Physics are as.

(i) Classical Physics

(ii) Quantum Physics or modern Physics.

The classical Physics believes in singular nature i.e. only the particle nature of matter. It provides macroscopic vision of matter. It is based upon Newton's laws of mechanics and Maxwell's laws of Electromagnetism.

The Quantum Physics believes in dual nature i.e. both particle and wave nature of matter. It provides microscopic vision of matter.

It is based upon Planck's quantum theory of light and De-Broglie's idea of matter wave. In Practical field, the common branches of Physics are:

(i) Mechanics	(ii) Optics	(iii) Heat and Thermodynamics
(iv) Electricity & Magnetism	(v) Astro Physics	(vi) Electronics
(vii) Fluid mechanics	(viii) Spectroscopy	(ix) Nuclear Physics
(x) Waves & Sound.	(xi) Solid state Physics	(xii) Bio Physics

CONTRIBUTION TO THE PHYSICAL SCIENCES BY THE ISLAMIC WORLD

1. **Ibn-Al-Haitham** was a **physicist**. He developed the **laws of reflection** and **refraction.** He constructed **"pin hole camera".** He wrote many books. His famous book is **"Kitabul-Manazir".**
2. **Al Khawarizmi** was a **mathematician.** He was the founder of analytical algebra. He invented the term logarithm (algorithm). His famous book is **"Hisabul-Jubr-wal-Muqabla".**
3. **AL-Battani** was an **astronomist.** He made calculations in connection with solar system, changes in seasons, eclipses of moon and sun, and other astronomical phenomenon.
4. **Jabir-Ibne-Hayyan** was a **chemist.** He derived various laws of chemistry on the basis of experiments.
5. **Omer Khayyam** was a **mathematician** and **poet.**
6. **Al-Razi** was the most prominent and a great **physician.** He wrote about 200 Original monographs.
7. **Abu-Rehan Al-Beruni** was an **astronomer, physician** and **mathematician.** His famous book is **"Kitab-ul-Qanoon-ul-Masoodi".** It is considered as an encyclopedia of astronomy.
8. **Yakoob Bin Ishaq Al-Kindi** wrote many books on **mathematics, astronomy** and other subjects.
9. **Ibn-e-sina** was famous for his original research in the field of medicine. He gave **intravenous injections** by means of a silver syringe. His famous book is **"Al-Qanoon-fil-Tib" (Qanoon).** He also wrote **Al-Shifa,** an encyclopedia of philosophy.

MEASUREMENTS AND THE SYSTEM OF UNITS

To measure the physical quantities we need some units.

There are three systems of units.

1. C. G. S system.
2. British Engineering system and
3. M. K. S system

1. C. G. S. System:

In this system units of length, mass and time are centimeter, gram and second respectively. All these are fundamental units.

2. British Engineering System:

In this system units of **length, force** and **time** are **foot, pound** and **second** respectively. These are fundamental units, while the unit of mass is a derived unit which is "Slug" in this System.

3. M. K. S. System:

In this system the units of length, mass and time are meter, kilogram and second respectively. All these are fundamental units.

BASIC SI UNITS

In this system the units of length, mass, time, electric currents, thermodynamic temperature, luminous intensity and amount of substance are meter, kilogram, second, Ampere, Kelvin, Candela and Mole respectively.

Meter (m):

It is defined as 1,650,763.73 wavelengths of the orange light emitted under certain carefully defined conditions by an atom of single pure isotope of Krypton (Kr^{86}).

Its multiples and submultiples are as follows.

10 millimeters = 1cm.

100 cm = 1 m.

1000 m = 1 km.

Kilogram (Kg):

It is the mass of a certain Platinum cylinder kept at the international Bureau of weights and measures in Paris.

The submultiples of kilogram are as follows:

1000 gm = 1 Kg

1000 mg = 1 gm

Second (s):

A second is the duration of 9192631770 periods of radiations corresponding to the transition between two hyperfine levels of the ground state of Cesium –133 atoms.

The multiples of second are minute and hour.

60 seconds = 1 minute

60 minutes = 1 hour

Ampere (A):

Ampere is the current, which if maintained in two straight parallel conductors of infinite length of negligible circular cross section, and placed 1m apart in a vacuum, would produce between the conductors a force equal to 2×10^{-7} N/m of length.

Kelvin (K):

Kelvin is 1/273.16 of the thermodynamic temperature of the triple point of water. Triple point of water is the point at which three state of water i.e. liquid, solid and saturated vapours coexist.

Candela (cd):

Candela is the luminous intensity of a surface $\frac{1}{6000000}$ m^2 of a black body at the temperature of freezing platinum under a pressure of 101325 N/m^2

Mole (mol):

Mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 Kg of Carbon –12.

DIMENSION

It is used to denote the nature of a physical quantity. The symbol L, M and T are used to specify the dimensions of any physical quantity. The nature of a physical quantity is always expressed as some combinations of the fundamental quantities, mass, length and time.

The dimensions of velocity are $\frac{L}{T} = LT^{-1}$

The dimensions of acceleration are $\frac{L}{T^2} = LT^{-2}$

The dimensions of area are L^2

The dimensions of volume are L^3

The dimensions of force are

$$F = ma = MLT^{-2}$$

The dimensions of Pressure are

$$P = \frac{F}{A} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

Applications in equations:

In any equation the dimension of a physical quantity must be same on both side of the equation.

EXAMPLES:

$$S = V_i t + \frac{1}{2} at^2$$

Dimensionally this equation can be written as

$$L = \frac{L}{T} T + \frac{L}{T^2} T^2$$

$$L = L + L$$

$$L = L$$

Length = Length

Thus the above equation is dimensionally correct.

Dimensional checking of the formula of time period of simple Pendulum

$$T = 2\lambda \sqrt{\frac{\ell}{g}}$$

The dimension of T is T

The dimension of 2λ is Nil

The dimension of ℓ is L

The dimension of g is LT^{-2}

Then $$T = \sqrt{\frac{L}{LT^{-2}}}$$

$$T = \sqrt{T^2}$$

$$T = T$$

Hence the given formula is verified dimensionally.

SIGNIFICANT FIGURES

The number of digits which are reasonably reliable are called significant figures.

OR

All the digits in the measure quantity about which we are sure are called significant figures.

OR

In any measurement, the correctly known digits and the first doubtful digit are know as significant figures.

RULES TO COUNT SIGNIFICANT FIGURES:

1. Number of non-zero digits in a number are significant figures.
   e.g. In 15.2 significant figures. are 3.
2. If zero is between two significant, figures it is counted as significant figure.
   e.g. In 203 significant figures are 3.
3. Zero on the right of the significant figure are not counted.
   e.g. In 2100, significant figures are 2.
4. Zero on left of the significant figures are not counted.
   e.g. In 0.002, significant figure is 1.
5. Zero on right of a fractional number are counted.
   e.g. In 10.40, significant figures are four
6. In addition, subtraction, multiplication and division, the number of significant figures of result is reduced to the smallest number of significant figures of the number in value in calculation.
   e.g. 3.142 x 2.7 = 8.4834
   = 8.5 (rounded for low significant figures).
7. When we multiply the numbers then the significant figures in answer will be equals to least number of significant figures.
8. When we add or subtract the number then the number of decimal places in answer will be equals to least number of decimal places.

IMPORTANT QUESTIONS

Q.1. Name three Muslim Scientists? And write down their contribution in the field of science. **(1994)**

Q.2. What are the dimensions of angular velocity? Show that the equation $T = 2\pi\sqrt{\frac{l}{g}}$ is dimensionally correct. Where "T" is the time period of simple pendulum of length "l" at the place where acceleration due to gravity is "g". **(1995)**

Q.3. Give the names of three Muslim scientists who made remarkable contribution in the field of physics. **(1998)**

Q.4. Show that the following equations are dimensionally correct. **(2001)**

(i) $T = 2\pi\sqrt{\frac{l}{g}}$ **(ii)** $V = f\lambda$

Q.5. Show that equation $S=V_it+\frac{1}{2}at^2$ is dimensionally correct. **(2004 Failures)**

Q.6. Prove that the following equations are dimensionally correct.

(i) $V_f^2 - V_i^2 = 2aS$ **(2005 Failures)** **(ii)** $T = 2\pi\sqrt{\frac{m}{k}}$ **(2004)**

Q.7. What is Physics? What are its main branches?

Q.8. What are basic units? Give basic S.I units?

Q.9. Define Significant figures? Define rules for deciding the number of significant figures in a measured quantity?

Q.10. Find out the dimension of Momentum, pressure, Kinetic Energy and Acceleration. **(2006 Failures)**

Q.11. Give the dimensions of following: **(2012)**

(i) Torque **(ii)** Angular momentum **(iii)** Pressure **(iv)** K.E