Chapter =01

The Scope of Physics

THEORY NOTES

INTRODUCTION TO SCIENCE:

Science is the study of nature and materials scattered in this universe in order to obtain optimum benefits for the mankind and it also provides a dimension to discover "The Truth" of existence of this universe. Physics is the most basic discipline among all sciences as it deals with the basic laws that govern the functions of natural phenomena that occur m our universe. Physics evolves the vision and understanding of the things and happenings both in microscopic and in macroscopic levels. Moreover, physics provides us the foundation upon which other sciences can be better understood, analyzed and manipulated.

MAIN FIELDS OF SCIENCE:

i. The Biological Sciences ii. The Physical Sciences

I. THE BIOLOGICAL SCIENCES:

The sciences which deal with living things and their organisms are called biological sciences and these are further classified into zoology, botany, genetics, physiology, microbiology and anatomy etc.

II. THE PHYSICAL SCIENCES:

The sciences which deal with the composition, properties origin and inter conversion of matter and energy are called physical sciences. These are further divided into number of disciplines such as physics, mathematics, statistics, chemistry, geography, geology, astronomy and electronics etc.

HISTORY OF PHYSICS:

The roots of physics are as deep as the history of mankind. The technological aspect of Physics was even started in primitive ages of man when he knew about the production of fire by rubbing two stones together and when he used wood logs to cross the rivers and lakes. But philosophical aspect of physics took centuries for its evolution.

Egyptians, Greeks, Chinese and Arabs had been recognized as agents of developed centers of science and technology for long periods before Europeans took initiative in this field. As Physics covers the whole universe from macro to micro entity then it has been classified into a number of branches for detailed study of nature. With reference to dual nature of matter i.e. (i) particle nature and (ii) wave nature, there are two fields of Physics:

I. CLASSICAL PHYSICS:

It is based upon Newton's laws of motion, Galileo's relativity, Kepler's laws of planetary motion, Maxwell's laws of Electromagnetism, Kelvin's law of thermodynamics, Faraday's law of electromagnetic induction, Huygen's wave theory of light etc. This field of thoughts has been recognized prior to 1900 AD.

II. QUANTUM OR MODERN PHYSICS:

It is based upon Plank's quantum theory of light and De-Broglie's idea about dual nature of matter which developed revolution in the first quarter of the 20th century. Moreover, it deals with Einstein's relativity, particle physics, cosmology and solid state Physics.

CONTRIBUTION OF MUSLIM SCIENTISTS TOWARDS SCIENCE:

1. IBN-AL- HAITHAM (965-1040 A.D.):

Ibn-al-Haitham was a great scholar of physics and engineer of the Islamic world. His main contribution to physics was the research on optics. He discovered five laws of reflection and refraction of light and he invented pin hole camera. He wrote books on. the human eye and analytical geometry. I-'is most famous book on the light and optics is "Kitabul-Manazir".

2. MOHAMMAD BIN MUSA KHAWARIZMI (780-880 AD.):

Mohammad-bin-Musa Khawarizmi is recognized as one of the greatest mathematician of the Islamic world. He was an important member of the great institution of learning the "Baitul-Hikmat" (House of Wisdom).established by Caliph Mamun-al- Rashid. He was founder of analytical algebra and he wrote first ever book in the world on this subject named Hisabul-Jabr-wal-Muqabla. He developed the term algorithm (Logarithm). He also worked on geometry, geography and astronomy.

3. JABIR-BIN HAYYAN (776-803 AD.):

Jabir-bin-Hayyan is regarded as the greatest chemist of the world. He was first experimental chemist and he developed many physical processes such as crystallization, evaporation, sublimation, distillation, filtration etc. in chemical research He prepared Aqua-Regia which could dissolve gold, he also prepared sulphuric, nitric and tartaric acid. He wrote many books on chemistry.

4. AL-BATANI (858-929 AD.):

Al-Battani was a great a mathematician and astronomer of his time. He developed table for trigonometric functions. He made calculations in connection with solar system, prediction of moon and sun eclipses.

5. AL-BERUNI (973-1048 A.D.):

Al-Beiruni was simultaneously a mathematician, an astronomer, a historian and aphysician. He remain associated with Sultan Mahmood Ghazanavi and he also lived in India during the reign of Mughal King Akbar. He wrote famous book Al-Qanun-ul- Masudi which is considered as an encyclopedia of astronomy.

6 .OMER KHAYYAM (1044-1123 AD.) :

Omer Khayyarn was a versatile philosopher. mathematician and poet of the Islamic world. He developed theorem about binomial expansion and also about two parallel lines in geometry.

7. IBNE-E-SINA (980-1037 A.D.):

Ibn-e-Sina was one of the greatest physician from Islamic world. He was simultaneously a philosopher, mathematician and astronomer but his chief work was in the field of medicine. He wrote many books among which Al-Qanun-Fit-Tibb and Al-Shifa got international recognition. He introduced the use of catheters for extraction of urine in case of kidney failure. He gave intravenous injections by means of a Silver syringe.

8. AL-RAZI (864-930 AD.):

Al-Razi was the most prominent philosopher and physician. He developed chemical techniques for the preparation of drugs. He also worked on kidney stones, small pox and measles. He used anesthesia for operations.

9. YAQUB BIN ISHAQ AL-KINDI (800-873 AD.):

Yaqub bin Ishaq al-Kindi was honored with a title "The first Arab Philosopher". He wrote many research monographs on meteorology. He has about 241 books in his account in the subject of physics, mathematics, astronomy. He also worked on number system and physical geometry.

10. AL-FARABI (870-950 AD.):

Mohammed Al-Farabi was great mathematician,philosopher and musician of his time. He wrote more than 100 books on these topics.

PHYSICAL QUANTITIES:

A physical quantity is a quantity in physics that can be measured. Or a physical quantity is a physical property that can be quantified. Examples of physical quantities are mass, amount of substance, length, time, temperature, electric current, light intensity, force, velocity, density, and many others.

METER:

A unit of length that is one of the seven base SI units and is defined as the length of the path

traveled by light in a vacuum during a time interval of 1/299792458 of a second.

OR

Meter is defined as "The distance between the two marks on a Platinum-Iridium bar kept at $0^{o}C$ in the International Bureau of Weight and Measures near Paris."

One meter = 100 cm

One meter = 1000 mm

KILOGRAM:

Kilogram is the unit of mass in S.I. System."Kilogram is defined as the mass of a Platinum-Iridium cylinder placed in the International Bureau of Weight and Measures near Paris."

One kilogram = 1000gram

SECOND:

Second is the unit of time in S.I. System. A second is defined in terms of the time period of Cs-133 atoms. i.e." one second is equal to 9,192,631,770 periods of vibrations of Cs-133 atoms."

OR

Second is the interval which is equal to (1/86,400)th part of a mean solar day.

60 seconds = one minute

3600 seconds = one hour

FUNDAMENTAL UNITS:

The international system of units is based on seven independent units known as Fundamental or Basic Units. These are given here:

DERIVED UNITS:

The units that require two or more basic measurements of same units or different fundamental units for its definition are called derived units.

FUNDAMENTAL UNITS		
Quantity	**Unit**	**Symbol**
1. Length	meter	m
2. Mass	kilogram	kg
3. Time	second	s
4. Electric Current	ampere	A
5. Temperature	kelvin	K
6. Luminious Intensity	candela	Cd
7. Amount of Substance	mole	mol

DERIVED UNITS		
Quantity	**Unit**	**Symbol**
1. Area	square meter	m^2
2. Volume	cubic meter	m^3
3. Density	kilogram/ cubic meter	kg/m^3
4. Velocity	meter/second	m/s
5. Angular Velocity	radian/ second	r/s
6. Acceleration	meter/second square	m/s^2
7. Angular Accleration	radian/second square	rad/s^2
8. Frequency	hertz	Hz
9. Force	newton	N
10. Work energy	joule	J

DIMENSION:

Dimension is a philosophical word. In literature it means a line or direction. In mathematics it

means an axis but in physics it is used to denote the nature of a physical quantity) which comes from the involvement of fundamental quantities in that particular quantity. So each of the fundamental quantities is called Dimension. Hence the dimensions of physics are mass (M), length (L) and time (T). These are the fundamental quantities on which physics is based upon.

EXAMPLES:

S.No	Physical Quantity	Formula	Dimension	S.I Unit
1	Area	Length x breadth	L^2	m^2
2	Volume	Length x breadth x height	L^3	m^3
3	Density	Mass / Volume	$M L^{-3}$	$Kg\ m^{-3}$
4	Speed or Velocity	Distance/ Time	LT^{-1}	$m\ s^{-1}$
5	Acceleration	Velocity/Time	LT^{-2}	$m\ s^{-2}$
6	Force	Mass x acceleration	MLT^{-2}	$kgm\ s^{-2}$= N
7	Pressure	Force/Area	$ML^{-1}T^{-2}$	$kg\ m^{-1}\ s^{-2}$=Pa
8	Momentum	Mass/ Velocity	MLT^{-1}	$kqms^{-1}$
9	Work	Force x Displacement	ML^2T^{-2}	$kg\ m^{-2}\ s^{-2}$=J
10	Energy	Work	ML^2T^{-2}	$kg\ m^{-2}\ s^{-2}$=J
11	Power	Work / Time	ML^2T^{-3}	$kg\ m^{-2}\ s^{-3}$=W
12	Gravitational Constant	Force x Distance^2/Mass^2	$M^{-1}L^3T^{-2}$	$kg^{-1}\ m^3\ s^{-2}$
13	Torque or couple	Force x perpendicular distance	ML^2T^{-2}	N.m
14	Angular Momentum	mass x velocity x radius	ML^2T^{-1}	kgm^2s^{-1}
15	Angle	Arc length \ radius	dimension less	radian

SIGNIFICANT FIGURES:

"All the accurately known digits in a value and the first doubtful digit are known as significant figures." In the measurement of any physical quantity the number of digits about which we are sure are called significant figures All physical measurements involve some degree of inaccuracy due to human error. instrumental error or due to both and therefore the knowledge of precision of a measurement is very important. A significant figure is that which is known to be reasonably reliable. The last figure being reasonably correct guarantees the certainty of the preceding figures.

RULES FOR COUNTING SIGNIFICANT FIGURES:

(i) In whole number values. all the digits except zeros at the right side m recognized as significant figures.

(ii) In decimal number values the zeros at the right side of the number are counted as significant figures but the zeros at the left side are not taken as significant figures.

(iii) Power or exponents to a certain base are not taken as significant figures.

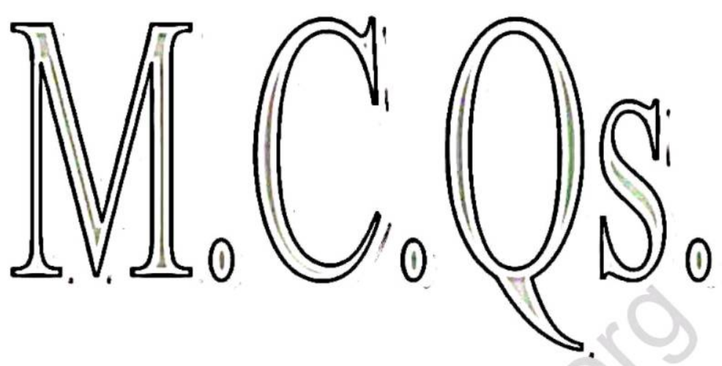
(iv) In addition and subtraction process, the result should be rounded off to contain as many as decimal

places as contained in the value of least number of decimal place.

(v) In multiplication and division process the result should be rounded off to contain as many as significant figures as contained in the factor of least significant figures.

FOR EXAMPLE:

S.NO	Value	No. of significant figures
1	0.00045	2(4,5)
2	1.2000	5(1,2,0,0,0)
3	505	3(5,0,5)
4	34000	2(3,4)
5	6.67×10^{32}	3(6,6,7)



1. Physics can be defined as the study of:
(a) Chemical Properties of matter
(b) Physical properties of matter
(c) Relation between matter and energy
(d) Both (b) and (c)

2. Physics can be defined as a branch of science based on a:
(a) Aberration and analysis of facts
(b) Experimental observation and quantitative measurement.
(c) Mathematical calculation and interpretation.
(d) Replication and verification of known facts.

3. The branch of physics deals with the study of production propagation and properties of light:
(a) Magnetics (b) Optics
(c) Statics (d) Acoustics

4. High energy physics deal with the:
(a) Study of electron behavior
(b) Study of electronic charges
(c) Study of mechanics of energetic bodies.
(d) Study of properties and behavior of elementary particles.

5. The significant figures in 0.0064 :
(a) 2 (b) 4 (c) 5 d) 1

6. Archimedes the Greek physicist has made significant contributions in the field of.
(a) High energy physics and electronics
(b) Nuclear and atomic Physics
(c) Mechanics hydraulics and hydrostatics
(d) Special theory of relativity

7. Al-Beruni is famous for finding out the :
(a) Distance of moon from earth
(b) Mass of the earth
(c) Diameter of earth's orbit
(d) Circumference of the earth

8. The book "Kitab-ul-Qanoon-ul Masoodi" was written by:
(a) Iben-e-Sina (b) Al-Razi
(c) Abu-Rehan Al-Beruni (d) Ibn-al-Haitham

9. Dr. Asalam was awarded noble Prize for his work on.

(a) Electronics (b) Radiations
(c) Optics (d) Grand unification theory

10. The first book on analytical "Hisab-ul-jabrwal-Moqabla" was written by:

(a) Al-Khawarzmi (b) Al-Beruni
(c) Al-Razi (d) Ibn-e-sina

11. "Kitab-ul-Manazir" the famous book on optical is written by:

(a) Ibn-e-Sina (b) Al-Khawrzmi
(c) Jabir-bin-Hayan (d) Ibn-ul-Hailham

12. In international system of units, the length mass time electric current temperature, intensity of light and quantity of light and quantity are called:

(a) Derived (b) basic
(c) Fundamental (d) only (b) and (c)

13. Written of the flowing physical quantity will be different units as compared to that of others:

(a) Weight (b) Tension
(c) Buoyant Force (d) Electromotive Force

14. Which one of the following is not of the same quantity?

(a) Horse Power (b) Calorie
(c) Joules (d) BTU

15. The S.I unit of current is:

(a) one volt (b) One ohm
(c) One ampere (d) One ohm-m

16. The famous mathematical and the founder of algebra was.

(a). Al Kindi (b) Al Khwarizmi
(c)Al Beruni (d) Naserudin tusi

17. Light year is a unit of:

(a) Distance (b) Light
(c) Time (d) Pressure

18. Some of the basic S.I. units are:

(a) Second Ampere mole
(b) Kelvin Ampere watt
(c) Candela Mole volt
(d) Meter Second watt

19. 10^{-9} second are equivalent to:

(a) Deci Second (b) Nano Second
(c) Milli second (d) Micro second

20. The S. I unit of temperature is:

(a) Fahrenheit (b) Kelvin
(c) Centigrade (d) Farad

21. One Angstrom equal:

(a) 10^{-8} cm (b) 10^{8} m
(c) 10^{-6} m (d) 10^{8} mm

22. In Physics the term "dimension" represent the:

(a) mechanical nature of a quantity
(b) chemical nature of quantity
(c) Physical nature of quantity
(d) electric nature of quantity

23. Dimension of pressure is:

(a) $ML^{-1}T^{-2}$ (b) $ML^{-2}T^{-3}$
(c) $ML^{-2}T^{-4}$ (d) $ML\,T^{-1}$

24. Which one of the following represents the dimension of power?

(a) L^2T^2 (b) MLT^2
(c) ML^2T^{-3} (d) $ML^{-2}T$

25. Which one of the following represent dimension for the unit of torque:

(a) M^2LT^2 (b) ML^2T^{-2}
(c) M^2LT^2 (d) MLT^2

PAST PAPER M.C.Qs.

2022

16 .The first Muslim scientist who invented intravenous injection is.

*Al- beruni * Ibn ul Haitham * Yaqub Al kindi **Ibn e Sina**

20 .The dimensions of ratio between angular momentum and linear momentum is:

*L^{-1} * ML *** L** * L^{-2}

33 .The number of significant figures in 2.0305:

*4 * 3 *** 5** * 2

2021

1 .The dimensions of Pressure is:

*** $ML^{-1}T^{-2}$** * $M^1L^{-2}T^{-3}$ * ML^2T^{-1} * MLT^{-1}

19. The dimensions of G are:

***$M^{-1}L^3T^{-2}$** *$M^2L^2T^{-2}$ *$M^{-1}L^2T^{-2}$ *MLT^{-2}

31. The dimensions of angular momentum are:

* $M^2L^2T^2$ * M^2L^2T * ML^2T *** ML^2T^{-1}**

2019

5.The dimensions of G/g are:

* $M^0L^{-1}T^{-2}$ * $M^1L^2T^{-2}$ * $M^{-1}L^2T^{-2}$ *** $M^{-1}L^2T^0$**

2018

3. The luminous intensity of light is measured in:

*decibel ***candela** *dioptre *watt/ m^2

6. The dimensions of angular velocity are :

* ML^0T^{-1} * ML^0T^{-2} *** $M^0L^0T^{-1}$** * $M^0L^0T^{-2}$

2017

5. Light year is the unit of:

*time ***distance** *velocity *luminous intensity

15. The number of significant figure in 1.6×10^{-19} is:

***2** *3 *4 *6

2016

1. The dimensions of G are:

***M^{-1}L^{3}T^{-2}** *M^{2}L^{2}T^{-2} *M^{-1}L^{2}T^{-2} *MLT^{-2}

12. KitabulManazir was written by:

***Ibn-Al Haitham** *Al Razi *Abu-Rehan Al Beruni *Jabir bin Hayyan

2015

2. Intravenous injection by means of silver syringe was initially used by:

***Ibn-e-Sina** *Omar Khayyam *Al-Beruni *Jabir bin Hayyan

11. The dimensions of 'G' are

*ML^{-1}T *ML^{-2}T^{3} ***M^{-1}L^{3}T^{-2}** *ML^{2}T^{-2}

2014

4. The unit of Luminous intensity is:

*Decibel ***Candela** *Dioptre *w/m^{2}

13. The Noble price in Physics was awarded to this Pakistani Scientist:

*Dr. Abdul Qadeer Khan *Dr. Saleem uz Zaman Siddiqui

***Dr. Abdus Salam** *Dr. Samar Mubarak

17. The dimension of Torque is:

* ML^{2} T *** ML^{2} T^{-2}** * ML^{2}T^{2} *MLT^{2}

2013

13. The dimension of force is:

*MLT *MLT^{-1} *MLT^{2} *** MLT^{-2}**

14. Light year is the unit of:

*time ***distance** *velocity *luminous intensity

2012

9. The products of two numbers 5.642 and 4.71 in the prospective significant number are:

*26.57382 * 26.574 *** 26.6** * 26.5738

2011

4. Light year is the unit of:

*time ***distance** *velocity *luminous intensity

16. The dimensions of 'G' are

*ML^{-1}T *ML^{-2}T^{3} ***M^{-1}L^{3}T^{-2}** *ML^{2}T^{-2}

2010

11. The number of significant figure in 7.050 x 10^{-2} is:

*2 *3 ***4** *6

12. Kitab ul Manazir is written by:

***Ibn ul Haitham** *Ibn e Sina *Al Razi *Al Beruni

13. The dimensions of angular momentum are:

* $M^2L^2T^2$ * M^2L^2T * ML^2T *** ML^2T^{-1}**

TEXTBOOK NUMERICALS

Q.1: Find the area of a rectangular plate having length (21.3 ± 0.2)cm and width (9.80 ± 0.10)cm.

Data:

Length of Rectangular plate =

$$l = (21.3 \pm 0.2)\text{cm}$$

Width of Rectangular plate =

$$w = (9.80 \pm 0.10)\text{cm}$$

Area of Rectangular Plate $= A =$?

Solution:

The Area of rectangular plate is given by

$$A = l \times w$$

$$A = (21.3 \pm 0.2) \times (9.80 \pm 0.10)$$

$$A = 208.74 \pm 2.13 \pm 1.96$$

$$\boxed{A = 208.74 \pm 4.09}$$

Result:

The Area of rectangular plate is 208.74 ± 4.09 cm.

Q.2: Calculate (a) the circumference of a circle of radius 3.5 cm and (b) area of a circle of radius 4.65 cm.

Data:

(a) Radius of Circle $= r_1 = 3.5$ cm

Circumference of Circle $= S =$?

(b) Radius of Circle $= r_2 = 4.65$ cm

Area of Circle $= A =$?

Solution:

(a) The Circumference of circle is given by

$$S = 2\pi r_1$$

$$S = 2 \times 3.14 \times 3.5$$

$$\boxed{S = 21.98\ cm}$$

(b) The Area of circle is given by

$$A = \pi r_2^2$$

$$A = 3.14 \times (4.65)^2$$

$$\boxed{A = 67.89\ cm^2}$$

Result:

(a) The circumference of circle is $21.98\ cm$

(b) The area of circle is $67.89\ cm^2$

Q.3: Show that the expression S = Vit + ½ at² is dimensionally correct, when S is a co-ordinate and has unit of length, Vi is velocity, a is acceleration, and t is time.

Data:

Dimension of S $= [S] = L$

Dimension of $V_i = [V_i] = LT^{-1}$

Dimension of t $= [t] = T$

Dimension of a $= [a] = LT^{-2}$

Dimension of $1/2 = \left[\frac{1}{2}\right] = No\ Dimension$

Proof:

L.H.S:

L.H.S $= [S]$

$$\boxed{L.H.S = L} \text{ ---(i)}$$

R.H.S:

$$R.H.S = [LT^{-1}][T] + [LT^{-2}][T]^2$$

$$R.H.S = LT^0 + LT^0 \qquad \{T^0 = 1\}$$

$R.H.S = L + L$

$R.H.S = 2L$

Since "2" has no dimension, Therefore

$\boxed{R.H.S = L}$---(ii)

Comparing eq (i) and eq (ii)

$\boxed{L.H.S = R.H.S}$ { Hence Proved}

Q.4: Suppose the displacement of a particle is related to a time according to expression $S = ct^3$. What are the dimensions of the constant c.

Data:

Dimension of S = $[S] = L$

Dimension of t= $[t] = T$

Dimension of c = $[c]$ =?

Solution:

According to the given condition

$S = ct^3$

or $c = \frac{S}{t^3}$

So, $[c] = \frac{L}{T^3}$

$\boxed{[c] = LT^{-3}}$

Result:

The dimension of c is LT^{-3}

Q.5: Estimate the number of litres of gasoline used by all Pakistan's car each year: Given: No. of cars in Pakistan = 500000. Average distance traveled per year by each car = 16000 km gasoline consumption 6km/litre

Data:

Number of litres of gasoline used by all Pakistan's car each year = n = ?

No. of cars in Pakistan = N = 500000

Average distance traveled per year by each car = S = 16000 km

Gasoline consumption = C = 6km/litre.

Solution:

First we calculate the total distance covered by all cars

$S_{total} = S \times N$

$S_{total} = 16000 \times 500000$

$S_{total} = 8000000000\ km$

Now, we will calculate the No. of liters of gasoline by all cars

$n = \frac{S_{total}}{C} = \frac{8000000000}{6}$

$\boxed{n = 1.33 \times 10^9 liters}$

Result: The number of litres of gasoline used by all Pakistan's car each year is $1.33 \times 10^9 liters$

PAST PAPER NUMERICALS

2022

Q.2 ii) Show that any two of the following equations are dimensionally correct:

a) $S = v_i t + 1/2\ at^2$ b) $T = 2\pi\sqrt{\frac{m}{k}}$ c) $T = 2\pi\sqrt{\frac{l}{g}}$

a) Data:

Dimension of S = $[S] = L$

Dimension of $V_i = [V_i] = LT^{-1}$

Dimension of t = $[t] = T$

Dimension of a = $[a] = LT^{-2}$

Dimension of $1/2 = \left[\frac{1}{2}\right] = No\ Dimension$

Proof:

L.H.S:

L.H.S $= [S]$

$\boxed{L.H.S = L}$ ---(i)

R.H.S:

$R.H.S = [LT^{-1}][T] + [LT^{-2}][T]^2$

$R.H.S = LT^0 + LT^0 \qquad \{T^0 = 1\}$

$R.H.S = L + L$

$R.H.S = 2L$

Since "2" has no dimension, Therefore

$\boxed{R.H.S = L}$---(ii)

Comparing eq (i) and eq (ii)

$\boxed{L.H.S = R.H.S}$ { Hence Proved}

b)) Data:

Dimension of time period $= [T] = T$

Dimension of 2π = No Dimension

Dimension of mass $= [M] = M$

Dimension of k $= [k] = MT^{-2}$

Solution:

$\boxed{L.H.S = [T] = T}$

And

$$R.H.S = \sqrt{\frac{M}{MT^{-2}}}$$

$$R.H.S = \sqrt{T^2}$$

$\boxed{R.H.S = T}$

$\boxed{L.H.S = R.H.S}$

c)) Data:

Dimension of time period $= [T] = T$

Dimension of 2π = No Dimension

Dimension of mass $= [L] = L$

Dimension of k $= [g] = LT^{-2}$

Solution:

$\boxed{L.H.S = [T] = T}$

And

$$R.H.S = \sqrt{\frac{L}{LT^{-2}}}$$

$$R.H.S = \sqrt{T^2}$$

$\boxed{R.H.S = T}$

$\boxed{L.H.S = R.H.S}$

2017

2(vii) Show that the expression $f = \frac{1}{2l}\sqrt{\frac{F \times l}{m}}$ is dimensionally correct and find the dimension of Kinetic Energy.

Data:

Dimension of frequency $= [f] = T^{-1}$

Dimension of **2** $= [2]$ = NIL

Dimension of Force $= [F] = MLT^{-2}$

Dimension of length $= [l] = L$

Dimension of mass $= [m] = M$

Solution:

$\boxed{L.H.S = [f] = T^{-1}}$

And

$$R.H.S = \frac{1}{L}\sqrt{\frac{MLT^{-2} \times L}{M}}$$

$$R.H.S = \frac{1}{L}\sqrt{L^2T^{-2}}$$

$$R.H.S = \frac{1}{L} \times LT^{-1}$$

$\boxed{R.H.S = T^{-1}}$

$\boxed{L.H.S = R.H.S}$

Now,

$$\boxed{K.E = \frac{1}{2}mv^2 = [M][LT^{-1}]^2 = ML^2T^{-2}}$$

2016

Q.2 (ii) Show that the following formulae are dimensionally correct:

(a) $V = f\lambda$. (b) $T = 2\pi\sqrt{\frac{m}{k}}$

(a) Data:

Dimension of speed=$[v] = LT^{-1}$

Dimension of frequency=$[f] = T^{-1}$

Dimension of wavelength $= [\lambda] = L$

Solution:

$\boxed{L.H.S = [v] = LT^{-1}}$

And

$R.H.S = [T^{-1}][L]$

$\boxed{R.H.S = LT^{-1}}$

$\boxed{L.H.S = R.H.S}$

(b) Data:

Dimension of time period $=[T] = T$

Dimension of 2π = No Dimension

Dimension of mass $= [M] = M$

Dimension of k $= [k] = MT^{-2}$

Solution:

$\boxed{L.H.S = [T] = T}$

And

$R.H.S = \sqrt{\frac{M}{MT^{-2}}}$

$R.H.S = \sqrt{T^2}$

$\boxed{R.H.S = T}$

$\boxed{L.H.S = R.H.S}$

2013

Q.2(xv) **Same as 2016 Q.2 (ii)**

2012

Q.2 (ii) Give the dimensions of the following quantities: (a) Torque (b) Angular momentum (c) Pressure (d) K.E

Dimension of Torque $= \tau = Fd = MLT^{-2} \times L = ML^2T^{-2}$

Dimension of Angular Momentum $= l = mvr = M \times LT^{-1} \times L = ML^2T^{-1}$

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

Dimension of Kinetic Energy $= K.E = \frac{1}{2}mv^2 = M \times (LT^{-1})^2 = ML^2T^{-2}$