Physics is the science of how matter and energy interact and affect each other over time and space. Physics functions in an exciting dimension. What we mean by this is that things keep changing in the world of physics with every discovery. As theories progress and discoveries are made, not only the answer but the whole question changes. Due to this, many individuals define physics by what it was rather than what it is and will be.Physics is an ever-evolving field of science that aspires to describe the universes fundamental laws. From the tiny particles that make up matter to the massive forces that govern the cosmos, physics covers many topics and concepts that continue to captivate us. If you are a physics enthusiast or student looking to dive deeper into physics, plenty of resources are available here. These physics blog posts contain information on various physics concepts, theories, discoveries and cutting-edge experiments. This physics repository contains over 1800+ scholarly articles in physics. It is an excellent resource for researchers and students, with articles covering various topics, from particle physics to astrophysics. By exploring these resources, you can better understand the fundamental laws that govern the universe.Exploring the Fundamentals: A Guide to Basic Physics Physics LawsPhysics FormulasPhysics ConstantsValues of Physics ConstantsRelation Between Physics ConceptsDifference Between Physics ConceptsClassification of Physics ConceptsApplications of Physics ConceptsPhysics SI UnitsDerivation of Physics FormulasPhysics ScientistsPhysics PuzzlesPhysics Resources for Students and Educators Physics Made Easy: Resources to Ace Your ExamBYJUS Physics offers an extensive collection of more than 1800 articles designed to serve as valuable study resources for students. These articles cover a wide range of physics concepts and have been carefully categorized under their parent topics for easy navigation. Each article is available for free and can be accessed through collapsible tables that provide links to the relevant content. At BYJUS, we are committed to providing the latest and most relevant information to our students, which is why we regularly update our library with improved or new material. With our comprehensive physics resources, students can enhance their understanding of physics and excel in their academic pursuits. NCERT Resources and Supplements for CBSE studentsThe Central Board of Secondary Education abbreviated as CBSE is one of the most prominent and prestigious educational boards of India. We, at BYJUS, provide various resources for CBSE students to help students with their exams. The study materials given here are prepared with respect to the latest syllabus. These resources include syllabus, books, sample papers, question papers, NCERT solutions, NCERT exemplar solutions, important questions and CBSE notes. Below, we have provided an exhaustive list of all the resources that a student would require for efficient preparation of exams. CBSE Student EssentialsPhysics is a science that studies the structure of matter and how the universes fundamental building blocks interact. Its scope ranges from the infinitesimally small objects studied using the principles of quantum mechanics to the entirety of the cosmos, explored using general relativity.The cornerstones of modern physics are relativity theory and quantum mechanics. Quantum mechanics describes the physical properties of atoms and subatomic particles. At the same time, relativity revolutionized our understanding of elementary particles and their interactions and enabled predictions of astronomical phenomena like black holes and gravitational waves.Physicists use the International System of Units (SI) to use a system agreed upon by scientists worldwide.Physics is called the king of science because it helps us understand how nature works.It is possible for theoretical physics to exist without Maths but it gets difficult to analyze and describe the universal phenomena without mathematical hypothesis.Physics and Biology, when combined together, help scientists learn more about biological systems on a molecular or atomic level.Physics and Chemistry may overlap when the subject under consideration is matter composed of electrons and nuclei made of protons and neutrons.Physics is important because it helps us understand the fundamental nature of the universe. It improves the quality of life by providing quantitative and analytical skills in fields like engineering, medicine and science.At BYJUS, our learning approach combines world-class teachers, innovative technology, proven pedagogical methods and data science to deliver personalized learning, feedback, and assessment for students. Stay tuned to BYJUS and KEEP FALLING IN LOVE WITH LEARNING! There is no doubt that all the scientific discoveries and inventions to date have revolutionized every aspect of our life. It has strongly influenced the way we think and the way we lead our lives. Owing to scientific inventions, we were able to find answers to questions which we thought we could never answer. A scientist is someone who explores the nature of the universe. On the other hand, an investigator is someone who tries to create useful devices and products. A few people have been successful in both endeavours. Given below is a list of discoveries that includes 17 famous scientists and their discoveries. Photon, also known as light quantum, is a tiny energy packet of electromagnetic radiation. This concept originated in Albert Einsteins explanation of the photoelectric effect, in which he proposed the existence of discrete energy packets during the transmission of light. Albert Einstein was best known for his General and Special theory of relativity and the concept of mass-energy equivalence (E = mc2.)J.J Thomson, an English physicist and a Nobel Laureate in Physics, is credited and honoured with the discovery of the electron, which was the first subatomic particle to be discovered. Thomson managed to show that cathode rays were composed of previously unknown negatively charged particles (electrons), which he calculated and inferred might have smaller bodies than atoms and a substantial charge-mass ratio. He is also credited for finding the first evidence for the existence of isotopes for stable elements.Ernest Rutherford, a New Zealand chemist is regarded as the father of nuclear physics. He was the first to propose that an atom comprises a small charged nucleus surrounded by empty space and is circled by tiny electrons which later, became known as the Rutherford model. He is credited with the discovery of protons and hypothesized the existence of the neutron.John Daltons major contribution was his theory on atoms which consists of five parts as follows:Atoms are made of tiny particles known as atomsAtoms are indivisible and indestructibleAtoms of a given element are identical in size, mass, and chemical propertiesIn a chemical reaction, atoms separate, combine and rearrangeDalton made a lot of discoveries based on his observations.James Chadwick, a British physicist, was awarded the Nobel Prize in 1935 for his discovery of the neutron. Bombarding elements with neutrons can result in the penetration and splitting of nuclei generating an enormous amount of energy. This way, Chadwicks findings were pivotal to the discovery of nuclear fission and ultimately, the development of the atomic bomb.Isaac Newtons discoveries created a launchpad for future developments in science. His most noteworthy innovations were as follows:Newtons three laws of motion set the foundation for modern classical mechanics.The discovery of gravitational force gave us the ability to predict the movement of heavenly bodies.His discovery of calculus gave us a potent mathematical tool, aiding the precise analytical treatment of the physical world.Isaac Newton is one of the greatest mathematicians and physicists of all time, and his inventions and discoveries widened the reach of human thoughts.Charles-Augustin de Coulomb is best known for what now is known as the Coulombs law, which explains electrostatic attraction and repulsion. He formulated this law to study the law of electrostatic repulsion put forward by the English scientist Joseph Priestley. He also extensively worked on the friction of machinery, the elasticity of metal and silk fibres. The SI unit of electric charge Coulomb, is named after him.Georg Simon Ohm, a German Physicist, discovered the law named after him, known as the Ohms Law which states that the current flowing a conductor is directly proportional to its voltage and inversely proportional to its resistance. Faraday was a man devoted to discovery through experimentation. He was famous for never giving up on ideas that came from scientific intuition. When he thought of an idea, he would keep experimenting through multiple failures until he got what was expected. Below is the list of his few noteworthy discoveries:Discovery of Electromagnetic InductionDiscovery of BenzeneFaradays Laws of ElectrolysisGas Liquefication and RefrigerationMichael Faraday is one of the revered scientists of all time.Thomas Edison made a lot of key inventions and discoveries. Here, we have listed a few noteworthy ones:Invented the carbon rheostatDiscovered incandescent lightInvented the motion picture cameraInvented the fluorescent electric lampDiscovered thermionic emissionEdison has been described as Americas greatest inventor. He developed many devices in fields like mass communication and electric power generation. He was one of the pioneers in applying the principles of organized science and teamwork to the process of invention, working with many researchers and employees.Henri Becquerel was a French physicist best known for his work on radioactivity for which he won a Nobel Prize. As a result, the SI unit of radioactivity Becquerel is named after him.Marie Sklodowska-Curie was a chemist who conducted pioneering research on radioactivity. She was the first woman to win a Nobel Prize. She is most famous for the discovery of the elements Polonium and Radium.Max Planck, a German Physicist, is best known for his proposition of the quantum theory of energy for which he was awarded the Nobel Prize. His work contributed significantly to the atomic and subatomic processes.During his work on electromagnetism, Heinrich reported another important phenomenon known as the Photoelectric effect. He noticed that UV rays made the metal lose charges faster than otherwise, which led him to publish his findings in the journal Annalen der Physik. He did not investigate this effect further on. Later, in 1905, Albert Einstein proposed that light came in discrete packets of energy known as the photons. This discovery led to the development of Quantum mechanics.Wilhelm Conrad Rntgen, a German physicist, produced and detected electromagnetic radiation in a wavelength range known as X-rays. This discovery earned him a Nobel Prize in Physics. As discussed before, Rutherford described an atom as consisting of a positive centre mass surrounded by orbiting electrons. Neils Bohr suspected that electrons revolved in quantized orbits. Having suspected this, Bohr worked on Rutherfords model and proved that particles couldnt occupy just any energy level.Enrico Fermi was an Italian-American physicist who created the worlds first nuclear reactor. He is widely known as the architect of the nuclear age and the architect of the atomic bomb. He won a Nobel Prize in Physics for his work on induced radioactivity by neutron bombardment. He also made significant contributions in the field of quantum theory, statistical mechanics and nuclear and particle physics. Put your understanding of this concept to test by answering a few MCQs. Click Start Quiz to begin! Select the correct answer and click on the Finish buttonCheck your score and answers at the end of the quiz Visit BYJUS for all Physics related queries and study materials 0 out of 0 arewrong 0 out of 0 are correct 0 out of 0 are Unattempted View Quiz Answers and Analysis Every measurement has two parts. The first is a number (n), and the next is a unit (u). Q = nu. For example, the length of an object = 40 cm. The number expressing the magnitude of a physical quantity is inversely proportional to the unit selected.Download Complete Chapter Notes of Units and MeasurementsDownload NowIf n1 and n2 are the numerical values of a physical quantity corresponding to the units u1 and u2, then n1u1 = n2u2. For example, 2.8 m = 280 cm; 6.2 kg = 6200 g.Table of Contents Fundamental and Derived QuantitiesThe quantities that are independent of other quantities are called fundamental quantities. The units that are used to measure these fundamental quantities are called fundamental units. There are four systems of units, namely CGS, MKS, FPS and SI.The quantities that are derived using the fundamental quantities are called derived quantities. The units that are used to measure these derived quantities are called derived units.Fundamental and supplementary physical quantities in the SI systemFundamental QuantitySystem of UnitsCGSMKSFPSLengthcentimetermeterfootMassgramkilogrampoundTimesecondsecondsecondPhysical QuantityUnitSymbolLengthmetermMasskilogramkgTimesecondsElectric currentampereAThermodynamic temperaturekelvinKIntensity of lightcandelacdQuantity of substancemolemolSupplementary QuantitiesPlane angleRadianradSolid angleSteradiansrMost SI units are used in scientific research. SI is a coherent system of units.A coherent system of units is one in which the units of derived quantities are obtained as multiples or submultiples of certain basic units. The SI system is a comprehensive, coherent and rationalised MKS. The ampere system (RMKSA system) was devised by Prof. Giorgi.Meter: A meter is equal to 1650763.73 times the wavelength of the light emitted in a vacuum due to the electronic transition from 2p10 state to 5d5 state in Krypton-86. But in 1983, the 17th General Assembly of Weights and Measures adopted a new definition for the meter in terms of the velocity of light. According to this definition, a meter is defined as the distance travelled by light in a vacuum during a time interval of 1/299, 792, 458 of a second.Kilogram: The mass of a cylinder of platinum-iridium alloy kept in the International Bureau of Weights and Measures preserved at Serves near Paris is called one kilogram.Second: The duration of 9192631770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of cesium-133 atoms is called one second.Ampere: The current which, when flowing in each of two parallel conductors of infinite length and negligible cross-section and placed one meter apart in vacuum, causes each conductor to experience a force of 2 10-7 newtons per meter of length is known as one ampere.Kelvin: The fraction of 1/273.16 of the thermodynamic temperature of the triple point of water is called Kelvin.Candela: The luminous intensity in the perpendicular direction of a surface of a black body of area 1/600000 m2 at the temperature of solidifying platinum under a pressure of 101325 Nm-2 is known as one candela.Mole: The amount of a substance of a system which contains as many elementary entities as there are atoms in 12 10-3 kg of carbon-12 is known as one mole.Radian: The angle made by an arc of the circle equivalent to its radius at the centre is known as a radian. 1 radian = 57o17l45ll.Steradian: The angle subtended at the centre by one square meter area of the surface of a sphere of radius one meter is known as steradian.Some Important ConclusionsAngstrom is the unit of length used to measure the wavelength of light. 1 = 10-10 m.Fermi is the unit of length used to measure nuclear distances. 1 Fermi = 10-15 meter.A light year is the unit of length for measuring astronomical distances.Light year = distance travelled by light in 1 year = 9.4605 1015 m.Astronomical unit = Mean distance between the sun and earth = 1.5 1011 m.Parsec = 3.26 light years = 3.0841016 m.Barn is the unit of area for measuring scattering cross-section of collisions. 1 barn = 10-28 m2.Chronometer and metronome are time-measuring instruments. The quantity having the same unit in all the systems of units is time. Also Read: List of All SI UnitsMACRO PrefixesMICRO PrefixesKilo (K) 103Mega (M) 106Giga (G) 109Tera (T) 1012Peta (P) 1015Exa (E) 1018Zetta (Z) 1021Yotta (y) 1024milli (m) 10-3( ) 10-6nano (n) 10-9pico (p) 10-12femto (f)10-15atto (a) 10-18zepto (z) 10-21yocto (y) 10-24Note: The following are not used in the SI system.deca 101 deci 10-1hecta 102 centi 10-2 How to Write Units of Physical Quantities?1. Full names of the units, even when they are named after a scientist, should not be written with a capital letter. For example, newton, watt, ampere, meter2. The unit should be written either in full or in agreed symbols only3. Units do not take the plural form. For example, 10 kg but not 10 kgs, 20 w but not 20 ws4. No full stop or punctuation mark should be used within or at the end of symbols for units. For example, 10 W but not 10 W. What Are Dimensions?Dimensions of a physical quantity are the powers to which the fundamental units are raised to obtain one unit of that quantity.Dimensional AnalysisDimensional analysis is the practice of checking relations between physical quantities by identifying the dimensions of the physical quantities. These dimensions are independent of the numerical multiples and constants, and all the quantities in the world can be expressed as a function of the fundamental dimensions. Read More: Dimensional AnalysisDimensional FormulaThe expression showing the powers to which the fundamental units are to be raised to obtain one unit of a derived quantity is called the dimensional formula of that quantity.If Q is the unit of a derived quantity represented by Q = MaLbTc, then MaLbTc is the dimensional formula, and the exponents a, b, and c are called dimensions.What Are Dimensional Constants?The physical quantities with dimensions and a fixed value are called dimensional constants. For example, gravitational constant (G), Plancks constant (h), universal gas constant (R), velocity of light in a vacuum (C), etc.What Are Dimensionless Quantities?Dimensionless quantities are those which do not have dimensions but have a fixed value.Dimensionless quantities without units:Pure numbers, , e, sin , cos , tan etc.Dimensionless quantities with units: Angular displacement radian, Joules constant joule/calorie, etc.What Are Dimensional Variables?Dimensional variables are those physical quantities which have dimensions and do not have a fixed value. For example, velocity, acceleration, force, work, power, etc.What Are the Dimensionless Variables?Dimensionless variables are those physical quantities which do not have dimensions and do not have a fixed value. For example, specific gravity, refractive index, the coefficient of friction, Poissons ratio, etc.Law of Homogeneity of DimensionsIn any correct equation representing the relation between physical quantities, the dimensions of all the terms must be the same on both sides. Terms separated by + or must have the same dimensions.A physical quantity Q has dimensions a, b and c in length (L), mass (M) and time (T), respectively, and n1 is its numerical value in a system in which the fundamental units are L1, M1 and T1 and n2 is the numerical value in another system in which the fundamental units are L2, M2 and T2, respectively, then$\begin{array}{l}{{n}_{2}}={{n}_{1}}{{\left[\frac{{{L}_{1}}}{L{}_{2}} \right]}^{a}}{{\left[\frac{{{M}_{1}}}{{{M}_{2}}} \right]}^{b}}{{\left[\frac{{{T}_{1}}}{{{T}_{2}}} \right]}^{c}}\end{array}$Limitations of Dimensional AnalysisDimensionless quantities cannot be determined by this method. Also, the constant of proportionality cannot be determined by this method. They can be found either by experiment (or) by theory.This method does not apply to trigonometric, logarithmic and exponential functions.This method will be difficult in the case of physical quantities, which are dependent upon more than three physical quantities.In some cases, the constant of proportionality also possesses dimensions. In such cases, we cannot use this system.If one side of the equation contains the addition or subtraction of physical quantities, we cannot use this method to derive the expression.Some Important Conversions1 bar = 106 dyne/cm2 = 105 Nm-2 = 105 pascal76 cm of Hg = 1.013106 dyne/cm2= 1.013105 pascal = 1.013 bar.1 toricelli or torr = 1 mm of Hg = 1.333103 dyne/cm2= 1.333 millibar.1 kmph = 5/18 ms-11 dyne = 10-5 N,1 H.P = 746 watt1 kilowatt hour = 36105 J1 kgwt = g newton1 calorie = 4.2 joule1 electron volt = 1.60210-19 joule1 erg = 10-7 joule Some Important Physical ConstantsVelocity of light in vacuum (c) = 3 108 ms-1Velocity of sound in air at STP = 331 ms-1Acceleration due to gravity (g) = 9.81 ms-2Avogadro number (N) = 6.023 1023/molDensity of water at 4oC = 1000 kgm-3 or 1 g/cc.Absolute zero = -273.15oC or 0 KAtomic mass unit = 1.66 10-27 kgQuantum of charge (e) = 1.602 10-19 CStefans constant = 5.67 108 W/m2/K4Boltzmanns constant (K) = 1.381 10-23 JK-1One atmosphere = 76 cm Hg = 1.013 105 PaMechanical equivalent of heat (J) = 4.186 J/calPlancks constant (h) = 6.626 10-34 JsUniversal gas constant (R) = 8.314 J/molKPermeability of free space (0) = 4 10-7 Hm-1Permittivity of free space (0) = 8.854 10-12 Fm-1The density of air at S.T.P. = 1.293 kg m-3Universal gravitational constant = 6.67 10-11 Nm2kg-2Derived SI units with Special NamesPhysical Quantity SI UnitSymbolFrequencyhertzHzEnergyjouleJForcenewtonNPowerwattWPressurepascalPaElectric charge orquantity of electricitycoulombCElectric potential difference and emfvoltVElectric resistanceohm$\begin{array}{l}\Omega\end{array}$Electric conductancesiemenSElectric capacitancefaradFMagnetic fluxweberWbInductancehenryHMagnetic flux densityteslaTIlluminationluxLxLuminous fluxlumenLm Dimensional Formulas for Physical QuantitiesPhysical QuantityUnitDimensional FormulaAcceleration or acceleration due to gravityms2LT2Angle (arc/radius)radMoLoToAngular displacementradMoloToAngular frequency (angular displacement/time)rads1T1Angular impulse (torque x time)NmsML2T1Angular momentum (I)kgm2s1ML2T1Angular velocity (angle/time)rads1T1Area (length x breadth)m2L2Boltzmanns constantJK1ML2T21Bulk modulus $\begin{array}{l}\left(\Delta P.\frac{V}{\Delta V} \right)\end{array}$Nm2, PaM1L1T2Calorific valueJkg1L2T2Coefficient of linear or areal or volume expansionoC1 or K11Coefficient of surface tension (force/length)Nm1 or Jm2MT2Coefficient of thermal conductivityWm1K1MLT31Coefficient of viscosity $\begin{array}{l}\left(F=\eta A\frac{dv}{dx} \right)\end{array}$poiseML1T1Compressibility (1/bulk modulus)Pa1, m2N2M1LT2Density (mass/volume)kgm3ML3Displacement, wavelength, focal lengthmLElectric capacitance (charge/potential)CV1, faradM1L2T4I2Electric conductance (1/resistance)Ohm1 or mho or siemenM1L2T3I2Electric conductivity (1/resistivity)siemen/metre or Sm1M1L3T3I2Electric charge or quantity of electric charge (current x time)coulombITElectric currentampereIElectric dipole moment (charge x distance)CmLTIElectric field strength or intensity of electric field (force/charge)NC1, Vm1MLT3I1Electric resistance $\begin{array}{l}\left(\frac{potential\ difference}{current} \right)\end{array}$ohmML2T3I2Emf (or) electric potential (work/charge)voltML2T3I1Energy (capacity to do work)jouleML2T2Energy density $\begin{array}{l}\left(\frac{energy}{volume} \right)\end{array}$Jm3ML1T2Entropy $\begin{array}{l}\left(\Delta S=\Delta Q/T \right)\end{array}$J1ML2T21Force (mass x acceleration)newton (N)MLT2Force constant or spring constant (force/extension)Nm1MT2Frequency (1/period)HzT1Gravitational potential (work/mass)Jkg1L2T2Heat (energy)J or calorieML2T2Illumination (Illuminance)lux (lumen/metre2)MT3Impulse (force x time)Ns or kgms1MLT1Inductance (L) $\begin{array}{l}\left(energy =\frac{1}{2}L{{I}^{2}} \right)\end{array}$ orcoefficient of self-inductionhenry (H)ML2T2I2Intensity of gravitational field (F/m)Nkg1L1T2Intensity of magnetization (I)Am1L1IJoules constant or mechanical equivalent of heatJcal1MoLoToLatent heat (Q = mL)Jkg1MoL2T2Linear density (mass per unit length)kgm1ML1Luminous fluxlumen or (Js1)ML2T3Magnetic dipole momentAm2L2IMagnetic flux (magnetic induction x area)weber (Wb)ML2T2I1Magnetic induction (F = Bil)NI1m1 or TMT2I1Magnetic pole strength (unit: amperemeter)AmLIModulus of elasticity (stress/strain)Nm2, PaML1T2Moment of inertia (mass x radius2)kgm2ML2Momentum (mass x velocity)kgms1MLT1Permeability of free space $\begin{array}{l}\left(\mu_o = \frac{4\pi Fd^{2}}{m_1m_2} \right)\end{array}$Hm1 or NA2MLT2I2Permittivity of free space $\begin{array}{l}\left({{\varepsilon }_{o}}=\frac{{{Q}_{1}}{{Q}_{2}}}{4\pi F{{d}^{2}}} \right)\end{array}$Fm1 or C2N1m2M1L3T4I2Plancks constant (energy/frequency)JsML2T1Poissons ratio (lateral strain/longitudinal strain)MoLoToPower (work/time)Js1 or watt (W)ML2T3Pressure (force/area)Nm2 or PaML1T2Pressure coefficient or volume coefficientoC1 or11Pressure headmMoLToRadioactivitydisintegrations per secondMoLoT1Ratio of specific heatsMoLoToRefractive indexMoLoToResistivity or specific resistance$\begin{array}{l}\Omega\end{array}$mML3T3I2Specific conductance or conductivity (1/specific resistance)siemen/metre or Sm1M1L3T3I2Specific entropy (1/entropy)KJ1M1L2T2Specific gravity (density of the substance/density of water)MoLoToSpecific heat (Q = mst)Jkg11MoL2T21Specific volume (1/density)m3kg1M1L3Speed (distance/time)ms1LT1Stefans constant$\begin{array}{l}\left(\frac{heat\ energy}{area\ x\ time\ x\ temperatur{{e}^{4}}} \right)\end{array}$.Wm24MLoT34Strain (change in dimension/original dimension)MoLoToStress (restoring force/area)Nm2 or PaML1T2Surface energy density (energy/area)Jm2MT2TemperatureoC or MoLoToTemperature gradient $\begin{array}{l}\left(\frac{change\text{ in temperature}}{\text{distance}} \right)\end{array}$oCm1 or m1MoL1ToThermal capacity (mass x specific heat)J1ML2T21Time periodsecondTTorque or moment of force (force x distance)NmML2T2Universal gas constant (work/temperature)Jmol11ML2T21Universal gravitational constant$\begin{array}{l}\left(F = G.\frac{{{m}_{1}}{{m}_{2}}}{{{d}^{2}}} \right)\end{array}$Nm2kg2M1L3T2Velocity (displacement/time)ms1LT1Velocity gradient (dv/dx)s1T1Volume (length x breadth x height)m3L3Water equivalentkgMLoToWork (force x displacement)JML2T2 Quantities Having the Same Dimensional FormulaImpulse and momentum.Work, torque, the moment of force, energy.Angular momentum, Plancks constant, rotational impulse.Stress, pressure, modulus of elasticity, energy density.Force constant, surface tension, surface energy.Angular velocity, frequency, velocity gradient.Gravitational potential, latent heat.Thermal capacity, entropy, universal gas constant and Boltzmanns constant.Force, thrust.Power, luminous flux. Applications of Dimensional AnalysisDimensional analysis is very important when dealing with physical quantities. In this section, we will learn about some applications of dimensional analysis.Fourier laid down the foundations of dimensional analysis. The dimensional formulas are used to:Verify the correctness of a physical equation.Derive a relationship between physical quantities.Converting the units of a physical quantity from one system to another system.Checking the Dimensional ConsistencyAs we know, only similar physical quantities can be added or subtracted. Thus, two quantities having different dimensions cannot be added together. For example, we cannot add mass and force or electric potential and resistance.For any given equation, the principle of homogeneity of dimensions is used to check the correctness and consistency of the equation. The dimensions of each component on either side of the sign of equality are checked, and if they are not the same, the equation is considered wrong.Let us consider the equation given below,The dimensions of the LHS and the RHS are calculatedAs we can see, the dimensions of the LHS and the RHS are the same. Hence, the equation is consistent.Deducing the Relation among Physical QuantitiesDimensional analysis is also used to deduce the relation between two or more physical quantities. If we know the degree of dependence of a physical quantity on another, that is, the degree to which one quantity changes with the change in another, we can use the principle of consistency of two expressions to find the equation relating to these two quantities. This can be understood more easily through the following illustration.Example: Derive the formula forcentripetal forceF acting on a particle moving in a uniform circle.As we know, the centripetal force acting on a particle moving in a uniform circle depends on its mass m, velocity v and the radius r of the circle. Hence, we can writeF = ma vb rcWriting the dimensions of these quantities,As per the principle of homogeneity, we can write,a = 1, b + c = 1 and b = 2Solving the above three equations, we get, a = 1, b = 2 and c = -1.Hence, the centripetal force F can be represented as,Recommended VideosUnits & Dimensions SI System and ParallaxIt is an expression that relates derived quantities to fundamental quantities. But it is not related to the magnitude of the derived quantity.We know that, F = ma (1)Mass is a fundamental quantity, but acceleration is a derived quantity and can be represented in terms of fundamental quantities.a = [LT2] (2)Using (1) and (2),F = [MLT2]This is the dimension of force.Dimensional analysis is based on the principle that two quantities can be compared only if they have the same dimensions. For example, I can compare kinetic energy with potential energy and say they are equal, or one is greater than another because they have the same dimension. But I cannot compare kinetic energy with force or acceleration as their dimensions are different.Suppose I have the following equation,F = Ea.Vb. TcWhere, F = Force; E = Energy; V = Velocity; M = MassWe need to find the value of a, b and c.Following are the dimensions of the given quantities,F = [MLT2], E = [ML2T2], V = [LT1]According to dimensional analysis, the dimension of RHS should be equal to LHS; hence,[MLT2] = [ML2T2]a . [LT1]b. [T]c[MLT2] = [Ma L2a+b T2ab+c]Now, we have three equations,a = 12a+b = 12a b + c = 2Solving the three equations, we get,a = 1, b = 1 and c = 1.The standard quantity with which a physical quantity of the same kind is compared is called a unit.This is because mass, length and time are independent of each other. All the other quantities in mechanics can be expressed in terms of mass, length and time.Significant figures are those digits in a number known with certainty plus one more uncertain number.The dimensions of a physical quantity are the powers to which the fundamental quantities are raised to represent that physical quantity. Acceleration due to gravity is the acceleration gained by an object due togravitational force. Its SI unit is m/s2. It has both magnitude and direction; hence, its a vector quantity. Acceleration due to gravity is represented by g. The standard value of g on the surface of the earth at sea level is 9.8 m/s2.Download Complete Chapter Notes of GravitationDownload NowJEE Main 2021 LIVE Physics Paper Solutions 24 Feb Shift-1 Memory-basedAcceleration Due to Gravity Formula, Unit and ValuesAcceleration Due to Gravity (g)SymbolgDimensional FormulaM0L1T-2SI Unitms-2Formulag = GM/r2Values of g in SI9.806 ms-2Values of g in CGS980 cm s-2Table of Contents What Is Gravity?Gravity is the force with which theearth attracts a body towards its centre. Let us consider two bodies of masses, ma and mb. Under the application of equal forces on two bodies, the force in terms of mass is given bymb = ma[aA/aB]; this is called an inertial mass of a body.Under the gravitational influence on two bodies,FA = GMmA/r2,FB = GMmB/r2,mB = [FB/FA] mA More on Gravitation: The above mass is called a gravitational mass of a body. According to the principle of equivalence, the inertial mass and gravitational mass are identical. We will be using this while deriving acceleration due to the gravity given below.Suppose a body [test mass (m)] is dropped from a height h above the surface of the earth [source mass (M)]; it begins to move downwards with an increase in velocity as it reaches close to the earths surface.We know that the velocity of an object changes only under the action of a force; in this case, the force is provided by gravity.Under the action of gravitational force, the body begins to accelerate toward the earths centre, which is at a distance r from the test mass.Then, ma = GMm/r2 (Applying principle of equivalence) a = GM/r2 . . . . (1)The above acceleration is due to the gravitational pull of the earth, so we call it acceleration due to gravity; itdoes not depend upon the test mass. Its value near the surface of the earth is 9.8 ms-2.Therefore, the acceleration due to gravity (g) is given by = GM/r2. Formula of Acceleration Due to GravityForce acting on a body due to gravity is given by f = mgWhere f is the force acting on the body, g is the acceleration due to gravity, and m is the mass of the body.According to the universal law of gravitation, f = GmM/(r+h)2Where,f = Force between two bodiesG = Universal gravitational constant (6.6710-11 Nm2/kg2)m = Mass of the objectM = Mass of the earthr = Radius of the earthh = Height at which the body is from the surface of the earthAs the height (h) is negligibly small compared to the radius of the earth, we re-frame the equation as follows:f = GmM/r2Now, equating both expressions,mg = GmM/r2 g = GM/r2Therefore, the formula of acceleration due to gravity is given by g = GM/r2Note: It depends on the mass and radius of the earth.This helps us understand the following:All bodies experience the same acceleration due to gravity, irrespective of their mass.Its value on earth depends upon the mass of the earth and not the mass of the object. Acceleration Due to Gravity on the Surface of EarthEarth is assumed to be a uniform solid sphere with a mean density. We know that,Density = mass/volumeThen, = M/[4/3 R3] M = [4/3 R3]We know that g = GM/R2.On substituting the values of M, we get,g = 4/3 [RG]At any distance r from the centre of the earth,g = 4/3 [RG]The value of acceleration due to gravity g is affected byAltitude above the earths surface.Depth below the earths surface.The shape of the earth.Rotational motion of the earth. Variation of g with HeightAcceleration due to gravity at a height (h) from the surface of the earthConsider a test mass (m) at a height (h) from the surface of the earth. Now, the force acting on the test mass due to gravity isF = GMm/(R+h)2Where M is the mass of the earth, and R is the radius of the earth. The acceleration due to gravity at a certain height is h, thenmgh= GMm/(R+h)2 gh= GM/[R2(1+ h/R)2] . . . . . . (2)The acceleration due to gravity on the surface of the earth is given byg = GM/R2 . . . . (3)On dividing equations (3) and (2), we getgh= g (1+h/R)-2. . . . . . (4)This is the acceleration due to gravity at a height above the surface of the earth. Observing the above formula, we can say that the value of g decreases with an increase in the height of an object, and the value of g becomes zero at an infinite distance from the earth. Check: Keplers Laws of Planetary MotionApproximation Formula:From equation (4)when h