I'm not robot

Introduction to Physical Quantities In physics, a physical quantity is a measurable property that has both a numerical value and a unit. Examples of physical quantities include speed and velocity. To represent a physical quantity, it must have both a numerical magnitude and a unit. For instance, the letter "v" can represent velocity, volume, or potential difference (voltage), but the unit provides context to what "v" represents. **Importance of Units** All physical quantities consist of a numerical value and a unit. The units provide essential information about what is being measured. Without units, it's impossible to understand the context of a measurement. For example, if someone says "the speed is 10", it doesn't make sense without knowing whether the unit is meters per second or kilometers per hour. **Estimating Physical Quantities** Learning important physical quantities is crucial in physics. Knowing these quantities helps when making estimates. Some useful quantities to memorize include: * Diameter of an atom: 10 nm * Wavelength of UV radiation: 10 nm * Height of an adult human: 2 m * Distance between Earth and Sun (1 AU): 1.5 × 10^11 m * Mass of a hydrogen atom: 10^-27 kg * Mass of an adult human: 70 kg * Speed of sound in air: 300 m/s **Cambridge International AS and A Level Physics** The Cambridge International AS and A Level Physics course builds on the skills acquired at Cambridge IGCSE level. The syllabus includes theoretical concepts, current applications of physics, and practical skills. The emphasis is on understanding concepts, applying physics ideas in novel contexts, and acquiring knowledge. The course encourages creative thinking and problem-solving skills that are transferable to future careers. The course covers topics such as kinematics, accelerated motion, dynamics, forces, vectors, moments, work, energy, and more. It's ideal for learners who want to study physics or related subjects at university or pursue a career in science. Momentum & Matter & Materials: Notes - Exploring Electric Fields & Current, Potential Difference, & Resistance - Kirchhoff’s Laws & Resistance & Resistivity - Waves & Practical Circuits - Superposition of Waves & Stationary Waves: Notes - Understanding Atoms Atoms are incredibly small (10–10 m), requiring an electron microscope to view them. Through Rutherford’s alpha-scattering experiment, we know that every atom contains: - A positively charged nucleus - Electrons surrounding the nucleus Each electron has a negative charge and is held in place by the strong electrostatic force of attraction between the nucleus and electrons. Rutherford's experiments showed that the nucleus contains most of the mass of the atom, with its diameter being approximately 0.00001 times the diameter of a typical atom. The electron has a much smaller mass than protons or neutrons, while protons and neutrons have equal mass. Electron charge is equal and opposite to proton charge. Isotopes: - Every atom of an element has the same number of protons as any other atom with the same element. - Proton number is sometimes called atomic number (Z symbol), Z = 6 for carbon because every carbon atom has 6 protons. - Atoms of an element can have different numbers of neutrons, and this is called an isotope. Specific Charge: - Specific charge of a particle is the ratio of its charge to its mass, in coulombs per kilogram. - The electron has the largest specific charge of any particle. 1.2 Stable & Unstable Nuclei: Strong Nuclear Force A stable isotope has nuclei that do not disintegrate, and there must be a force holding them together - called the strong nuclear force, which overcomes electrostatic forces between protons in the nucleus. Important points about the strong nuclear force: - Its range is no more than 3-4 femtometers. - The range is similar to the diameter of a small nucleus. - It has an attractive effect from 3-4 fm down to about 0.5 fm, after which it becomes a repulsive force preventing neutrons and protons from being pushed together. Radioactive Decay: - Alpha radiation consists of alpha particles comprising two protons and two neutrons. - This diagram shows what happens to an unstable nucleus when it emits an alpha particle, decreasing nucleon number (A) by 4 and atomic number (Z) by 2. Beta decay occurs in neutron-rich nuclei, where a neutron transforms into a proton, resulting in beta radiation consisting of electrons. The symbol for beta particles is (0)β(-1), indicating equal but opposite charges to protons and significantly smaller masses. Additionally, antineutrinos are produced with no charge. Gamma radiation is emitted by unstable nuclei with excess energy, passing through thick metal plates without mass or charge. Electromagnetic waves, including photons, travel at the speed of light in a vacuum. The wavelength of electromagnetic radiation is inversely proportional to frequency. Photons are emitted when charged particles lose energy, such as when electrons stop or change direction. The energy of a photon depends on its frequency and is expressed in millions of electron volts (MeV). In laser technology, a beam consists of photons of the same frequency, with power determined by the number of photons per second. The energy transferred per second is the product of the frequency and Planck's constant. Antimatter annihilates with matter when they meet, releasing radiation. Positron emission occurs in unstable nuclei where protons convert to neutrons. Particle and antiparticle energies are measured in MeV, with one electron volt equal to 1.6×10–19 joules. Dirac's theory of antiparticles predicted the existence of antimatter particles that would unlock rest energy when meeting their corresponding particle and annihilating each other. This process converts total mass into photons, with the same rest mass as the original particle and opposite charge if applicable. Dirac also predicted pair production, where a photon can suddenly change into a particle-antiparticle pair near a nucleus or electron, given sufficient energy. The minimum energy of such a photon is calculated by equating its energy to the combined rest energy of the particle and antiparticle. The electromagnetic force arises from the exchange of virtual photons between charged objects, causing them to exert equal and opposite forces on each other. This force transfers momentum but cannot be directly detected. In contrast, the weak nuclear force is responsible for changes in particles like beta- and beta+ decay, where a neutron transforms into a proton, an effect not caused by the electromagnetic force due to the neutron's uncharged nature. Each kind of decay produces a brand new pair, one of which is the antiparticle of the other. Neutrinos and their opposites barely interact with anything else, but when they do, it's because a neutrino teams up with a neutron to turn it into a proton and release a beta- particle in the process. Conversely, an antineutrino can transform a proton into a neutron and emit a beta+ particle as a result of pairing with a proton. This interaction occurs due to the exchange of particles known as W bosons, which have a rest mass and are either positively or negatively charged. These interactions are represented in diagrams below. Beta decay involves the W- boson decaying into a β- particle and an antineutrino and the W+ boson decaying into a β+ particle and a neutrino, both of which conserve charge. Electron capture is another process where a proton-rich nucleus can become more stable by turning a proton into a neutron via interaction with an inner-shell electron from outside the nucleus (electron capture). This interaction releases a neutrino from the atom's nucleus. The photon, W boson, and pion are referred to as force carriers because they facilitate the electromagnetic, weak nuclear, and strong nuclear forces respectively.

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