Definitions and Concepts for WJEC (Wales) Physics A-level

Unit 3: Oscillations and Nuclei

Absolute Zero: The lowest possible temperature of a system. At absolute zero the particles in the system have no kinetic energy, and theoretically the volume is zero.

Activity: The rate of decay of the radioactive nuclei in a given isotope. It is proportional to the total number of nuclei in the sample.

Alpha Radiation: The radiation of a particle containing two protons and two neutrons. It is strongly ionising, slow moving and positively charged so therefore deflected by a magnetic field.

Amplitude: The maximum displacement of an oscillator from its equilibrium position.

Angular Velocity: A measure of the speed of an object's angular rotation. It is equal to the frequency of rotation multiplied by 2π.

Atomic Mass Unit: 1/12 the mass of a Carbon-12 nuclei.

Avogadro Constant: The number of particles that make up one mole of any gas.

Background Radiation: Radiation that is found in small quantities all around us. It originates from natural sources such as rocks and cosmic rays as well as man-made sources such as nuclear accidents and medical sources.

Becquerel: The unit of radioactive activity.

Beta-Minus Radiation: Radiation consisting of a high energy electron that is mildly ionising, fast moving and negatively charged so therefore deflected by a magnetic field.

Beta-Plus Radiation: Radiation consisting of a high energy positron that is mildly ionising, fast moving and positively charged and so therefore deflected by a magnetic field in the opposite direction to beta-minus radiation.

Binding Energy per Nucleon: The amount of energy required to split a nucleus into all its separate constituent nucleons, divided by the number of nucleons involved. This division allows the value to be compared for different nuclei.

Binding Energy: The amount of energy required to split a nucleus into all its separate constituent nucleons. It is equivalent to the mass defect.

Boltzmann Constant: A constant relating the average kinetic energy of the particles in a

gas, to the gas' temperature.

Centripetal Acceleration: The acceleration of an object moving in circular motion. Any object in circular motion must have an acceleration since the direction of the object, and therefore the velocity of the object, is constantly changing.

Centripetal Force: The resultant force responsible for an object moving in circular motion. Centripetal forces always act towards the centre of the object's rotation.

Circular Motion: The motion of an object travelling in a circle. An object travelling in circular motion is always accelerating due its continual direction change. This means that a centripetal force is always required.

Critical Damping: The form of damping that reduces the displacement of an oscillating object to its equilibrium position in the quickest time possible and without further oscillation.

Damping: The dissipation of energy from an oscillating system. The consequence is that the amplitude of oscillation will decrease. Damping occurs when a force opposes the system's motion.

Decay Constant: The probability of a decay occurring per unit time.

Driving Frequency: The frequency at which a driving force causes a system to oscillate at.

Equation of State: An equation linking pressure, volume, number of moles, temperature and the ideal gas constant.

Exponential Law of Decay: Radioactive decay follows a decreasing exponential relationship. This means that the activity of a sample, or the number of unstable nuclei in a sample should always decrease exponentially.

First Law of Thermodynamics: A form of the conservation of energy. It states that the total energy supplied or removed from a system is equal to the sum of the change in internal energy and the work done on it.

Forced Oscillations: Repeated up and down oscillations, at the frequency of a driver. The amplitude of oscillation is small at high frequencies and large at low frequencies.

Free Oscillations: Oscillations that are not caused by a driver. An object will naturally oscillate at its natural frequency.

Frequency: The number of complete oscillations completed by an oscillator per unit period of time.

Gamma Radiation: High energy photons that are weakly ionising, travel at the speed of light and have no charge. This means they are not deflected by magnetic or electric fields.

Half-Life: The average time it takes for the number of radioactive nuclei in a sample to halve.

Heat: The movement of thermal energy from a hotter region to a cooler region. Heat is the movement of energy and so is not stored by a system.

Ideal Gas: A gas that meets the ideal gas assumptions. All the gas laws are based on ideal gases.

Internal Energy: The sum of the randomly distributed kinetic and potential energies of the particles in a given system.

Ionising Particles: Particles that have the ability to ionise atoms.

Kinetic Theory of Gases: A model of ideal gases that assumes their molecules move randomly, collide elastically, have negligible volume and have no intermolecular forces acting between them. There is a random energy distribution between the molecules.

Mass-Energy Equivalence: All matter has an associated energy. This means that mass can be converted into energy in the form of radiation.

Mass-Spring Oscillator: An oscillator whose time period depends only on the magnitude of the mass and the constant of the spring.

Molar Gas Constant: A fundamental constant, used in the ideal gas law.

Molar Mass: The mass of one mole of the substance in question.

Mole: The SI unit for the amount of a substance.

Nuclear Fission: The splitting of a large nucleus to produce smaller nuclei, fast moving neutrons and energy.

Nuclear Fusion: The fusing of two smaller nuclei to form a single nuclei producing a large quantity of energy. Very high temperatures and pressures are needed as well as high magnetic fields to contain the fusing plasma.

Overdamping: A type of damping where the system is damped more than required to stop the oscillations. It takes longer for the system to return to equilibrium than for critical damping.

Penetration Ability: A particle's ability to pass through different mediums.

Period: The time taken for an oscillator to complete one full oscillation.

Phase: A measure of how far through a complete cycle an oscillator is.

Pressure-Volume Graph: A graph showing how the volume of a gas changes with pressure. The area under the graph gives you the work done by the gas during the process.

Radian: A unit of angle. One radian is equal to the angle subtended by an arc whose length is equal to the radius of the circle.

Relative Molecular Mass: The ratio of the mass of a given molecule over the mass of one twelfth of a carbon-12 atom.

Resonance: Resonance occurs when the frequency of oscillations is equal to the natural frequency of the oscillating system. The rate of energy transfer is at a maximum during resonance.

Resultant Force: The single force that can replace all the individual forces acting on an object, and have the same effect.

Simple Harmonic Motion: Motion where the acceleration of an object is directly proportional, and in the opposite direction, to its displacement.

Simple Pendulum: An oscillator whose time period depends only on the length of the pendulum and the gravitational field strength at its location.

Specific Heat Capacity: The amount of energy required to increase the temperature of 1kg of a substance by 1 Kelvin.

Spontaneous Nature of Nuclear Decay: Radioactive decay is random - you cannot predict when a nucleus will decay or which nucleus will decay next.

Temperature: A measure of the average kinetic energy of the particles in a system. Absolute temperature is proportional to the mean kinetic energy.

Thermal Equilibrium: A stable state in which there is no thermal heat transfer between two regions with the same temperature.

Undamped System: A system from which no energy is dissipated, due to no opposing forces acting. An undamped system will oscillate infinitely.

Underdamping: A type of damping where energy is gradually removed from the system and the amplitude of oscillations slowly decreases.

Work Done by a Gas: For a system at constant pressure, the work done by a gas in changing volume is equal to the volume change multiplied by the pressure.