

Concepts of Science - Study Guide for Final Exam

Listed below are a number of concepts, people and techniques that you should be familiar with:

Chapter 1 Measurement: Scientific notation, units of measurement, the metric system, **Problems involving** converting to and from the metric system. You will be given metric-English conversion factors.

Chapter 2 The Structure of the Solar system: geocentric vs heliocentric system, Eratosthenes, Ptolemy, epicycle, Copernicus, Galileo, induction, deduction, phases of Venus, the scientific method, Kepler, Kepler's laws, Newton, the fate of the solar system, **Problems involving** Kepler's third law, the law of universal gravitation, and the velocity needed to keep a body in orbit. You will be given any formulas you need.

Chapter 3 Atomic Structure: Lavoisier and the significance of his experiment with HgO, Dalton, J. J. Thomson, cathode ray tube, Rutherford, models of the atom, atomic Weights, electrons, protons, neutrons, quarks, quantum Mechanics and the Uncertainty Principle, atomic Number and Atomic Mass, Isotopes, the Periodic table, Mendeleev, seeing atoms with STM and X-rays.

Chapter 4 Molecular Structure Molecule, ionic and covalent bonding, bond length, bond energy, chemical formulas, drawing structures, number of covalent bonds to H, C, N, O, halogens, acids and bases, acid strength, equilibrium constants, pH, hydrogen bonding, molecular weights, balancing chemical equations, the mole concept, molecular geometries, bond angles, chirality, enantiomers. **Problems involving** stoichiometry (given a mass of a reactant or product, calculate the mass of an additional reactant or product).

Chapter 5 Macromolecular Structure Monomers and polymers, biological polymers, proteins, amino acids, amino acid sequences, enzyme, catalyst, nucleic acids, DNA, RNA, the genetic code, nucleic acid synthesis, the mechanism of protein synthesis, base pairing, double helix, carbohydrates, starch, cellulose, lipids, micell, fats, lipid bilayer, mitochondria, ribosomes, DNA fingerprinting, Watson and Crick, virus, retrovirus, AIDS.

Problems involving stoichiometry, peptide sequences, and translating the genetic code (taking information from DNA to RNA to proteins).

Chapter 6 Cellular Structure The general structure of a cell, prokaryotic cells eukaryotic cells, four important classes of molecules (the molecules of life: proteins, nucleic acids, carbohydrates, lipids), structure of the cell wall, virus, DNA virus, RNA virus, virus life cycle, retrovirus, AIDS, strategies for treating AIDS.

Chapter 7 Working with Energy The first and second laws of thermodynamics, conservation of energy, entropy, measuring energy, various kinds of energy and how they interconvert, solar energy, geothermal energy, fuel cells, wind energy, biomass, global energy problems and potential solutions. **Problems involving** kinetic and potential energy, exothermic and endothermic reactions, heat of combustion.

Chapter 8 The Nature of Light Wavelength, frequency and energy of light, **Problems involving** the interconversion of wavelength and frequency, electromagnetic spectrum, the wave nature of light, the particle nature of light, lasers, global warming, CO₂, the greenhouse effect, **Problems involving** calculation of the amount of CO₂ released from a burning fuel, chlorofluorocarbons and the destruction of the ozone layer, F. S. Rowland, the role of chlorine atoms in ozone destruction, ozone and air pollution, acid rain, the concept of pH, solar energy, solar cells, the speed of light, Michelson and Morley, Einstein, the special theory of relativity, the concepts of relativistic mass, length, and time. **Problems involving** calculation of relativistic mass, length, and time (given the formulas).

Chapter 9 Nuclear Energy: Nuclear reactions, fission, fusion, nuclear waste, half-life, nuclear accidents, Chernobyl and Three Mile Island.

Chapter 10 Energy in Living Systems: Autotrophs, heterotrophs, photosynthesis, cellular metabolism, respiration, carbohydrates, ATP, global population.

Chapter 11 Cosmology: geologic time, the big bang, age of the universe, red shift, expanding universe, evidence for the big bang, stellar evolution, evolution of the chemical elements, four forces of nature.

Chapter 12 Geologic time: dating with radio isotopes, the concept of half-life, problems using half-life, carbon-14 dating, K-Ar dating.

Chapter 13 The Evolution of Living Organisms: The origin of life, Stanley Miller, reducing and nonreducing atmospheres, definition of a living organism, the central dogma of molecular biology, amino acids, RNA world, biological evolution, creationism, intelligent design, natural selection, *The Origin of Species*, Charles Darwin, Alfred R. Wallace, Thomas Malthus, Charles Lyell, Bishop Usher, Jean-Baptiste de Lamarck, species, population, evolution, genetic diversity, fossil record, gradualism, punctuated equilibrium, mass extinctions, molecular genetics, Homo erectus, Lucy, Homo sapiens, chromosome, gene, allele, mutation, paleontology.

Chapter 14 Genetics: Patterns of Inheritance: Gregor Mendel, homozygous, heterozygous, chromosome, gene, allele, dominant allele, recessive allele, phenotype, genotype, test cross, cloning. **Problems involving determination of offspring genotype and phenotype for monohybrid and dihybrid crosses.**

