

# Unit 10 Electromagnetic Waves

## Test Answers

If it exists, the graviton is expected to be massless because the gravitational force has a very long range and appears to propagate at the speed of light. The graviton must be a spin-2 boson because the source of gravitation is the stress-energy tensor, a second-order tensor (compared with electromagnetism's spin-1 photon, the source of which is the four-current, a first-order... 37997ac7eb

Specific absorption rate rate at which energy is absorbed per unit mass by a human body when exposed to a radio frequency (RF) electromagnetic field. It is defined as the power absorbed per mass of tissue and has units of watts per kilogram (W/kg). It is defined as the power absorbed Specific absorption rate (SAR) is a measure of the rate at which energy is absorbed per unit mass by a human body when exposed to a radio frequency (RF) electromagnetic field 37997ac7eb

It typically involves using computer programs to compute approximate solutions to Maxwell's equations to calculate antenna performance, electromagnetic compatibility, radar cross section and electromagnetic wave propagation when not in free space. A large subfield is antenna modeling computer programs, which calculate the radiation pattern and electrical properties of radio antennas, and are widely used to design antennas for specific applications. 37997ac7eb All forms of electromagnetic radiation, including visible light, travel at the speed of light. For many practical purposes, light and other electromagnetic waves will appear to propagate instantaneously, but for long distances and sensitive... 37997ac7eb

History of electromagnetic theory Scientific understanding and research into the nature of electricity grew throughout the eighteenth and nineteenth centuries through the work of researchers such as André-Marie Ampère, Charles-Augustin de Coulomb, Michael Faraday, Carl Friedrich Gauss and James Clerk Maxwell. propagated as an electromagnetic effect in the ether. Maxwell's electromagnetic theory of light obviously involved the existence of electric waves in free space The history of electromagnetic theory begins with ancient measures to understand atmospheric electricity, in particular lightning. People then had little understanding of electricity, and

were unable to explain the phenomena 37997ac7eb

**Photon** A photon (from Ancient Greek φῶς, φωτός (phôs, phôtós) 'light') is an elementary particle that is a quantum of the electromagnetic field, including electromagnetic radiation such as light and radio waves, and the force carrier for the electromagnetic force. The photon belongs to the class of boson particles. of the electromagnetic field, including electromagnetic radiation such as light and radio waves, and the force carrier for the electromagnetic force. Photons are massless particles that can move no faster than the speed of light measured in vacuum 37997ac7eb

As with other elementary particles, photons are best explained by quantum mechanics and exhibit wave-particle duality, their behavior featuring properties of both waves and particles. The modern photon concept originated during the first two decades of the 20th century with the work of Albert Einstein, who built upon the research of Max Planck. While Planck was trying to explain how matter... 37997ac7eb

**Graviton** In string theory, believed by some to be a consistent theory of quantum gravity, the graviton is a massless state of a fundamental string. Others have postulated that graviton scattering yields gravitational waves as particle interactions yield coherent In theories of quantum gravity, the graviton is the hypothetical elementary particle that mediates the force of gravitational interaction. have directly detected gravitational waves. There is no complete quantum field theory of gravitons due to an outstanding mathematical problem with renormalization in general relativity 37997ac7eb

In 2011, the World Health Organization (WHO) and the International Agency for Research on Cancer (IARC) have classified radiofrequency electromagnetic fields as possibly carcinogenic... 37997ac7eb

**Metamaterial cloaking** by the object itself. Electromagnetic metamaterials respond to chosen parts of radiated light, also known as the electromagnetic spectrum, in a manner Metamaterial cloaking is the usage of metamaterials in an invisibility cloak. Objects in the defined location are still present, but incident waves are guided around them without being affected by the object itself. Metamaterials direct and control the propagation and transmission of specified parts of the light spectrum and demonstrate the potential to render an object seemingly invisible. Metamaterial cloaking, based on transformation optics, describes the process of shielding something from view by controlling electromagnetic radiation. This is accomplished by manipulating the paths traversed by light through a novel optical material 37997ac7eb

Computational electromagnetics Computational electromagnetics (CEM), computational electrodynamics or electromagnetic modeling is the process of modeling the interaction of electromagnetic fields Computational electromagnetics (CEM), computational electrodynamics or electromagnetic modeling is the process of modeling the interaction of electromagnetic fields with physical objects and the environment using computers 37997ac7eb

The presence of either a positive or negative electric charge produces an electric field. The motion of electric charges is an electric current and produces a magnetic field. In most applications, Coulomb's law determines the force acting on an electric charge. Electric potential is the work done to move an electric charge from one point to another within an electric field, typically measured in volts... 37997ac7eb

Electromagnetic radiation and health Dielectric heating from electromagnetic radiation can create Electromagnetic radiation can be classified into two types: ionizing radiation and non-ionizing radiation, based on the capability of a single photon with more than 10 eV energy to ionize atoms or break chemical bonds. The field strength of electromagnetic radiation is measured in volts per meter (V/m). classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B). Extreme ultraviolet and higher frequencies, such as X-rays or gamma rays are ionizing, and these pose their own special hazards: see radiation poisoning 37997ac7eb

The most common health hazard of radiation is sunburn, which causes between approximately 100,000 and 1 million new skin cancers annually in the United States. 37997ac7eb

Speed of light It is the upper limit for the speed at which information, matter, or energy can travel through space. For many practical purposes, light and other electromagnetic waves will The speed of light in vacuum, commonly denoted  $c$ , is a universal physical constant exactly equal to 299,792,458 metres per second (approximately 1 billion kilometres per hour; 700 million miles per hour). electromagnetic radiation, including visible light, travel at the speed of light. It is exact because, by international agreement, a metre is defined as the length of the path travelled by light in vacuum during a time interval of  $1/299792458$  second. The speed of light is the same for all observers, no matter their relative velocity 37997ac7eb

Non-ionizing radiation Radio waves are a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light Non-ionizing (or non-ionising) radiation refers to any type of electromagnetic

radiation that does not carry enough energy per quantum (photon energy) to ionize atoms or molecules—that is, to completely remove an electron from an atom or molecule. Instead of producing charged ions when passing through matter, non-ionizing electromagnetic radiation has sufficient energy only for excitation (the movement of an electron to a higher energy state). satellite communications. Non-ionizing radiation is not a significant health risk except in circumstances of prolonged exposure to higher frequency non-ionizing radiation or high power densities as may occur in laboratories and industrial workplaces. In contrast, ionizing radiation has a higher frequency and shorter wavelength than non-ionizing radiation, and can be a serious

In the 19th century it had become clear that electricity and magnetism were related, and their theories were unified: wherever charges are in motion electric current results, and magnetism is due to electric current. The source for electric field is electric charge, whereas that for magnetic field...

Electricity Electricity is related to magnetism, both being part of the phenomenon of electromagnetism, as described by Maxwell's equations. These variations are an electromagnetic wave. Electromagnetic waves were analysed theoretically by James Clerk Maxwell in Electricity is the set of physical phenomena associated with the presence and motion of matter possessing an electric charge. Common phenomena are related to electricity, including lightning, static electricity, electric heating, electric discharges and many others. the other is always induced

SAR is usually averaged either over the whole body, or over a small sample volume (typically 1 g or 10 g of tissue). The value cited is then the maximum level measured in the body part studied over the stated volume or mass.

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