

Fale elektromagnetyczne

1. Select the correct statement:

- A. ultraviolet light has a longer wavelength than infrared
- B. blue light has a higher frequency than x rays
- C. radio waves have higher frequency than gamma rays
- D. gamma rays have higher frequency than infrared waves
- E. electrons are a type of electromagnetic wave

2.

Which of the following is NOT true for electromagnetic waves?

- A. they consist of changing electric and magnetic fields
- B. they travel at different speeds in vacuum, depending on their frequency
- C. they transport energy
- D. they transport momentum
- E. they can be reflected

3.

Maxwell's equations predict that the speed of electromagnetic waves in free space is given by:

- A. $\mu_0\epsilon_0$
- B. $(\mu_0\epsilon_0)^{1/2}$
- C. $1/\mu_0\epsilon_0$
- D. $1/(\mu_0\epsilon_0)^{1/2}$
- E. $1/(\mu_0\epsilon_0)^2$

4.

Maxwell's equations predict that the speed of light in free space is

- A. an increasing function of frequency
- B. a decreasing function of frequency
- C. independent of frequency
- D. a function of the distance from the source
- E. a function of the size of the source

5.

The Sun is about 1.5×10^{11} m away. The time for light to travel this distance is about:

- A. 4.5×10^{18} s
- B. 8 s
- C. 8 min
- D. 8 hr
- E. 8 yr

6.

If the electric field in a plane electromagnetic wave is given by $E_m \sin[(3 \times 10^6 \text{ m}^{-1})x - \omega t]$, the value of ω is:

- A. 0.01 rad/s
- B. 10 rad/s
- C. 100 rad/s
- D. 9×10^{14} rad/s
- E. 9×10^{16} rad/s

7.

Radio waves of wavelength 3 cm have a frequency of:

- A. 1 MHz
- B. 9 MHz
- C. 100 MHz
- D. 10,000 MHz
- E. 900 MHz

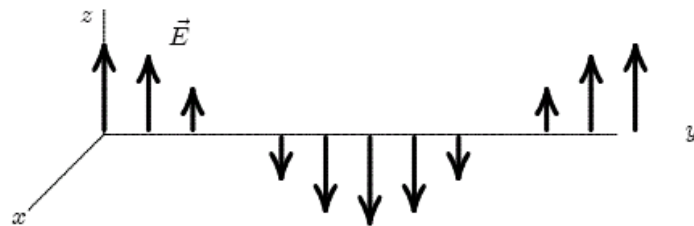
8.

An electromagnetic wave is generated by:

- A. any moving charge
- B. any accelerating charge
- C. only a charge with changing acceleration
- D. only a charge moving in a circle
- E. only a charge moving in a straight line

9.

The electric field for a plane electromagnetic wave traveling in the $+y$ direction is shown. Consider a point where \vec{E} is in the $+z$ direction. The \vec{B} field is:



- A. in the $+x$ direction and in phase with the \vec{E} field
- B. in the $-x$ direction and in phase with the \vec{E} field
- C. in the $+x$ direction and one-fourth of a cycle out of phase with the \vec{E} field
- D. in the $+z$ direction and in phase with the \vec{E} field
- E. in the $+z$ direction and one-fourth of a cycle out of phase with the \vec{E} field

10.

In a plane electromagnetic wave in vacuum, the ratio E/B of the amplitudes in SI units of the two fields is:

- A. the speed of light
- B. an increasing function of frequency
- C. a decreasing function of frequency
- D. $\sqrt{2}$
- E. $1/\sqrt{2}$

11.

If the electric field in a plane electromagnetic wave is along the y axis and its component is given by $E_m \sin(kx + \omega t)$, in SI units, then the magnetic field is along the z axis and its component is given by:

- A. $(E_m/c) \cos(kx + \omega t)$
- B. $-(E_m/c) \cos(kx + \omega t)$
- C. $-(E_m/c) \sin(kx + \omega t)$
- D. $E_m \cos(kx + \omega t)$
- E. $(E_m/c) \sin(kx + \omega t)$

12.

An electromagnetic wave is traveling in the positive x direction with its electric field along the z axis and its magnetic field along the y axis. The fields are related by:

- A. $\partial E/\partial x = \mu_0 \epsilon_0 \partial B/\partial x$
- B. $\partial E/\partial x = \mu_0 \epsilon_0 \partial B/\partial t$
- C. $\partial B/\partial x = \mu_0 \epsilon_0 \partial E/\partial x$
- D. $\partial B/\partial x = \mu_0 \epsilon_0 \partial E/\partial t$
- E. $\partial B/\partial x = -\mu_0 \epsilon_0 \partial E/\partial t$

13.

For an electromagnetic wave the direction of the vector $\vec{E} \times \vec{B}$ gives:

- A. the direction of the electric field
- B. the direction of the magnetic field
- C. the direction of wave propagation
- D. the direction of the electromagnetic force on a proton
- E. the direction of the emf induced by the wave

14.

The dimensions of $\vec{S} = (1/\mu_0) \vec{E} \times \vec{B}$ are:

- A. J/m^2
- B. J/s
- C. W/s
- D. W/m^2
- E. J/m^3

15.

A point source emits electromagnetic energy at a rate of 100 W. The intensity 10 m from the source is:

- A. 10 W/m^2
- B. 1.6 W/m^2
- C. 1 W/m^2
- D. 0.024 W/m^2
- E. 0.080 W/m^2

16.

A company claims to have developed material that absorbs light energy without a transfer of momentum. Such material is:

- A. impossible
- B. possible, but very expensive
- C. inexpensive and already in common use
- D. in use by NASA but is not commercially available
- E. a breakthrough in high technology

17.

Polarization experiments provide evidence that light is:

- A. a longitudinal wave
- B. a stream of particles
- C. a transverse wave
- D. some type of wave
- E. nearly monochromatic

18.

The relation $n_1 \sin \theta_1 = n_2 \sin \theta_2$, which applies as a ray of light strikes an interface between two media, is known as:

- A. Gauss' law
- B. Snell's law
- C. Faraday's law
- D. Cole's law
- E. law of sines

19.

The index of refraction of a substance is:

- A. the speed of light in the substance
- B. the angle of refraction
- C. the angle of incidence
- D. the speed of light in vacuum divided by the speed of light in the substance
- E. measured in radians

20.

The units of index of refraction are:

- A. m/s
- B. s/m
- C. radian
- D. m/s^2
- E. none of these