

Name: _____ Date: _____

- ___ 1. If the magnetic field in a plane electromagnetic wave is along the y axis and its component is given by $B^{\max} \sin(kx - \omega t)$, in SI units, then the electric field is along the z axis and its component is given by:
- A) $(cB^{\max}) \cos(kx - \omega t)$ D) $B^{\max} \cos(kx - \omega t)$
 B) $-(cB^{\max}/c) \cos(kx - \omega t)$ E) $(cB^{\max}/c) \sin(kx - \omega t)$
 C) $-(cB^{\max}/c) \sin(kx - \omega t)$
- ___ 2. Which of the following types of electromagnetic radiation travels at the greatest speed in vacuum?
- A) Radio waves D) Gamma rays
 B) Visible light E) All of these travel at the same speed
 C) X rays
- ___ 3. 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
- ___ 4. The order of increasing wavelength for blue (b), green (g), red (r), and yellow (y) light is:
- A) r, y, g, b B) r, g, y, b C) g, y, b, r D) b, g, y, r E) b, y, g, r
- ___ 5. If the electric field in a plane electromagnetic wave is along the y axis and its component is given by $E^{\max} \sin(kx + \omega t)$, in SI units, then the magnetic field is along the z axis and its component is given by:
- A) $(E^{\max}/c) \cos(kx + \omega t)$ D) $E^{\max} \cos(kx + \omega t)$
 B) $-(E^{\max}/c) \cos(kx + \omega t)$ E) $(E^{\max}/c) \sin(kx + \omega t)$
 C) $-(E^{\max}/c) \sin(kx + \omega t)$
- ___ 6. A sinusoidal electromagnetic wave with a maximum electric field of 100 V/m is incident normally on a surface with an area of 1 cm^2 and is completely absorbed. The energy absorbed in 10 s is:
- A) 1.3 mJ B) 13 mJ C) 27 mJ D) 130 mJ E) 270 mJ

- ___ 7. The electric field in unpolarized light:
- A) has no direction at any time
 - B) rotates rapidly
 - C) is always parallel to the direction of propagation
 - D) changes direction randomly and often
 - E) remains along the same line but reverses direction randomly and often
- ___ 8. The theoretical upper limit for the frequency of electromagnetic waves is:
- A) just slightly greater than that of red light
 - B) just slightly less than that of blue light
 - C) the greatest x-ray frequency
 - D) none of the above (there is no upper limit)
 - E) none of the above (but there is an upper limit)
- ___ 9. The product $\mu_0\epsilon_0$ has the same units as:
- A) (velocity)²
 - B) (velocity)^{1/2}
 - C) 1/velocity
 - D) 1/velocity²
 - E) 1/velocity^{1/2}
- ___ 10. The light intensity 10 m from a point source is 1000 W/m². The intensity 100 m from the same source is:
- A) 1000 W/m²
 - B) 100 W/m²
 - C) 10 W/m²
 - D) 1 W/m²
 - E) 0.1 W/m²
- ___ 11. Radio waves of wavelength 300 m have a frequency of:
- A) 10⁻³ kHz
 - B) 500 kHz
 - C) 1 MHz
 - D) 9 MHz
 - E) 108 kHz
- ___ 12. 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
- ___ 13. In a stack of three polarizing sheets the first and third are crossed while the middle one has its axis at 45° to the axes of the other two. The fraction of the intensity of an incident unpolarized beam of light that is transmitted by the stack is:
- A) 1/2
 - B) 1/3
 - C) 1/4
 - D) 1/8
 - E) 0

- ___ **14.** An unpolarized beam of light has intensity I_0 . It is incident on two ideal polarizing sheets. The angle between the axes of polarization of these sheets is θ . Find θ if the emerging light has intensity $I_0/4$:
- | | |
|----------------------------|----------------------------|
| A) $\sin^{-1}(1/2)$ | D) $\cos^{-1}(1/\sqrt{2})$ |
| B) $\sin^{-1}(1/\sqrt{5})$ | E) $\tan^{-1}(1/4)$ |
| C) $\cos^{-1}(1/2)$ | |
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- ___ **15.** Polarization experiments provide evidence that light is:
- | | |
|--------------------------|-------------------------|
| A) a longitudinal wave | D) some type of wave |
| B) a stream of particles | E) nearly monochromatic |
| C) a transverse wave | |
-
- ___ **16.** In a plane electromagnetic wave in vacuum, the ratio E^{\max}/B^{\max} of the field maxima in SI units is:
- | | |
|--|-----------------|
| A) the speed of light | D) $\sqrt{2}$ |
| B) an increasing function of frequency | E) $1/\sqrt{2}$ |
| C) a decreasing function of frequency | |
-
- ___ **17.** 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 |
|------------|----------|----------|------------|------------|
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- ___ **18.** Of the following human eyes are most sensitive to:
- | |
|---|
| A) red light |
| B) violet light |
| C) blue light |
| D) green light |
| E) none of these (they are equally sensitive to all colors) |
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- ___ **19.** Radio waves differ from visible light waves in that radio waves:
- | | |
|----------------------------|------------------------------|
| A) travel slower | D) have a lower frequency |
| B) have a higher frequency | E) require a material medium |
| C) travel faster | |
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- ___ **20.** Consider: radio waves (r), visible light (v), infrared light (i), x-rays (x), and ultraviolet light (u). In order of increasing frequency, they are:
- | | | | | |
|------------------|------------------|------------------|------------------|------------------|
| A) r, v, i, x, u | B) r, i, v, u, x | C) i, r, v, u, x | D) i, v, r, u, x | E) r, i, v, x, u |
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Answer Key

1. E
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2. E
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3. C
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4. D
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5. C
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7. D
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9. D
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10. C
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14. D
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17. D
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20. B
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