1) If unpolarized light of intensity I_0 passes through an ideal polarizer, what is the intensity of the emerging light?

A) $I_0/4$ B) $I_0/\sqrt{2}$ C) $I_0/16$ D) $I_0/2$ E) I_0

2) For a beam of light, the direction of polarization is defined as

A) the direction of the magnetic field's vibration.
B) the beam's direction of travel.
C) the direction of the electric field's vibration.
D) the direction that is perpendicular to both the electric and magnetic field vectors.

3) When light travels from air into water,

A) its wavelength changes, but its velocity and frequency do not change.
B) its velocity changes, but its frequency and wavelength do not change.
C) its frequency changes, but its velocity and wavelength do not change.
D) its velocity, wavelength and frequency all change.
E) its velocity and wavelength change, but its frequency does not change.

4) Monochromatic coherent light shines through a pair of slits. If the distance between these slits is decreased, which of the following statements are true of the resulting interference pattern? (There could be more than one correct choice.)

A) The distance between the maxima decreases.
B) The distance between the minima stays the same.
C) The distance between the maxima increases.
D) The distance between the minima increases.
E) The distance between the maxima stays the same.

5) A double–slit interference experiment is performed in the air. Later, the same apparatus is immersed in benzene (which has an index of refraction of 1.50), and the experiment is repeated. When the apparatus is in benzene, you observe that the interference fringes are

A) equally spaced as when the apparatus is in air.
B) more closely spaced than when the apparatus is in air.
C) more widely spaced than when the apparatus is in air.

6) What do we mean when we say that two light rays striking a screen are in phase with each other?

A) They alternately reinforce and cancel each other.
B) They are traveling at the same speed.
C) They have the same wavelength.
D) When the electric field due to one is a maximum, the electric field due to the other is also a maximum, and this relation is maintained as time passes.

7) Two beams of coherent light start out at the same point in phase and travel different paths to arrive at point P. If the maximum constructive interference is to occur at point P, the two beams must travel paths that differ by

A) an odd number of half–wavelengths.
B) a whole number of wavelengths.
C) a whole number of half–wavelengths.

8) Two beams of coherent light start out at the same point in phase and travel different paths to arrive at point P. If the maximum destructive interference is to occur at point P, the two beams must travel paths that differ by
A) an odd number of half–wavelengths.
B) a whole number of half–wavelengths.
C) a whole number of wavelengths.

9) In a double–slit experiment, it is observed that the distance between adjacent maxima on a remote screen is 1.0 cm. What happens to the distance between adjacent maxima when the slit separation is cut in half?
A) It decreases to 0.50 cm.
B) It increases to 2.0 cm.
C) It increases to 4.0 cm.
D) It decreases to 0.25 cm.
E) None of these choices are correct.

10) A single–slit diffraction pattern is formed on a distant screen. Assuming the angles involved are small, by what factor will the width of the central bright spot on the screen change if the wavelength of the illuminating light is doubled?
A) It will be cut to one–quarter its original size.
B) It will double.
C) It will become eight times as large.
D) It will be cut in half.
E) It will become four times as large.

11) What principle is responsible for light spreading as it passes through a narrow slit?
A) refraction B) diffraction C) polarization D) dispersion

12) Radio waves are diffracted by large objects such as buildings, whereas light is not noticeably diffracted. Why is this?
A) The wavelength of light is much greater than the wavelength of radio waves.
B) The wavelength of light is much smaller than the wavelength of radio waves.
C) Radio waves are unpolarized, whereas light is normally polarized.
D) Radio waves are polarized, whereas light is usually unpolarized.
E) Radio waves are coherent and light is usually not coherent.

13) Light of the same wavelength passes through two diffraction gratings. One grating has 4000 lines/cm, and the other one has 6000 lines/cm. Which grating will spread the light through a larger angle in the first–order pattern?
A) the 4000–line grating
B) the 6000–line grating
C) Both gratings spread the light the same.

14) Light in a frozen block of ice reflects off the ice–air interface at the surface of the block. What phase shift does it undergo?
A) 180°
B) 270°
C) 90°
D) 0°
E) It does not undergo any phase shift.

15) Light reflects off the surface of Lake Superior. What phase shift does it undergo?
A) 270°
B) 0°
C) 180°
D) 90°
E) It does not undergo any phase shift.

16) When a beam of light, originally traveling in air, enters a piece of glass having an index of refraction of 3/2, its wavelength
A) is reduced to 2/3 its original value.
B) increases by a factor of 3/2.
C) is unaffected.

17) The colors on an oil slick are caused by reflection and
A) polarization.
B) interference.
C) refraction.
D) ionization.
E) diffraction.

18) Three ideal polarizers are oriented as follows: The axis of the second polarizer is at an angle of 59.0° relative to the first one. The axis of the third polarizer is at an angle of 31.0° relative to the second one, so the axis of the axis of the third polarizer is perpendicular to the axis of the first one. Unpolarized light of intensity 18.6 W/m^2 is incident on the first polarizer.
(a) What is the intensity of the light after it passes through all three polarizers?
(b) What is the intensity of the transmitted light if the second polarizer is removed?

19) Unpolarized light of intensity I_0 passes through four ideal polarizing sheets. The polarizing angle of each sheet is rotated 30° from the one before it, so that the last sheet is aligned at 90° to the first sheet. What is the intensity of the light emerging from the fourth sheet in terms of I_0?

20) Polarized light of intensity S_0 passes through an ideal polarizer. If the electric vector of the polarized light is horizontal what, in terms of the initial intensity S_0, is the intensity of the light that passes through a polarizer if that polarizer is tilted 0.449 rad from the horizontal?

21) Unpolarized light is incident upon two ideal polarizing filters that do not have their transmission axes aligned. If 19% of the light passes through this combination, what is the angle between the transmission axes of the two filters?

22) A light beam having a wavelength of 470 nm in air is directed into glycerine at an angle of 75.0° with the normal in air. Glycerine has a refractive index of 1.47. ($c = 3.0 \times 10^8$ m/s)
(a) What are the frequency and wavelength of the light in the glycerine?
(b) What angle does the light beam make with the normal in the glycerine?

23) What is Brewster's angle for light traveling in vacuum and reflecting off a piece of glass having a refractive index of 1.52?

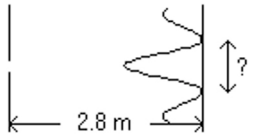
24) The critical angle for an air–glass interface is 42.6°. A light ray in air hits the interface, and the reflected ray is 100% polarized. What is the angle of refraction for that ray?

25) A double–slit experiment uses coherent light of wavelength 633 nm with a slit separation of 0.100 mm and a screen placed 2.0 m away.
(a) How wide on the screen is the central bright fringe?
(b) What is the distance on the screen between first–order and second–order bright fringes?
(c) What is the angular separation (in radians) between the central maximum and the first–order maximum?

26) In a two–slit experiment, a third–order bright fringe is observed at an angle of 7.10° away from the centerline. If the wavelength of light is 595 nm, how far apart are the two slits?

27) A pair of narrow slits that are 1.8 mm apart is illuminated by a monochromatic coherent light source. A fringe pattern is observed on a screen 4.8 m from the slits. If there are 5.0 bright fringes/cm on the screen, what is the wavelength of the monochromatic light?

28) The figure shows the resulting pattern when a single slit is illuminated by monochromatic light. The slit is 0.3×10^{-3} m wide and is illuminated by light of wavelength 506 nm. A diffraction pattern is seen on a screen 2.8 m from the slit. What is the linear distance on the screen between the first two diffraction minima on either side of the central diffraction maximum?



29) A beam of monochromatic light passes through a slit that is 11.0 μm wide. If the first order dark fringe of the resulting diffraction pattern is at an angle of 4.31° away from the centerline, what is the wavelength of light?

30) A beam of light of wavelength 610 nm passes through a slit that is 1.90 μm wide. At what the angle away from the centerline does the second dark fringe occur?

31) A diffraction grating is to be used to find the wavelength of the emission spectrum of a gas. The grating spacing is not known, but light of a known wavelength of 632.8 nm is deflected by 43.2° in the second order by this grating. Light of the wavelength to be measured is deflected by 34.9° in the second order. What is the wavelength of the light that is to be measured?

32) Monochromatic light is incident on a diffraction grating that is 75 mm wide and ruled with 50,000 lines. The second–order maximum is seen at 32.5°. What is the wavelength of the incident light?

33) A soap bubble with air on both sides has an index of refraction of 1.33. What minimum thickness of the wall of this bubble will ensure maximum reflectance of normally incident light having a wavelength of 530 nm?

34) The wavelength of light in a thin film is 360 nm and the wavelength of light in vacuum is 469 nm. What is the index of refraction for the film?

35) A puddle of water has a thin film of gasoline floating on it. A beam of light is shining perpendicular on the film. If the wavelength of light incident on the film is 560 nm and the indices of refraction of gasoline and water are 1.40 and 1.33, respectively, what must be the minimum thickness of the film to see a bright reflection?

36) Two very flat glass plates, 16 cm long, are in contact at one end and separated by 0.020 mm at the other end. The space between the plates is occupied by oil with index of refraction 1.45. The refractive index of the glass plates is 1.55. The plates are illuminated at normal incidence with monochromatic light, and fringes are observed. When the monochromatic light has a wavelength of 580 nm, how many bright fringes are visible in the pattern?

Answer Key
Testname: CH24_WAVE_NATURE_OF_LIGHT

1) D
2) C
3) E
4) C, D
5) B
6) D
7) B
8) A
9) B
10) B
11) B
12) B
13) B
14) D
15) C
16) A
17) B
18) (a) 1.81 $\mathrm{W/m^2}$ (b) 0 $\mathrm{W/m^2}$
19) 0.21 I_0
20) 0.812 S_0
21) 52°
22) (a) 6.38×10^{14} Hz, 320 nm (b) 41.1°
23) 56.7°
24) 34.1°
25) (a) 1.3 cm (b) 1.3 cm (c) 6.33 mrad
26) 1.44×10^{-5} m
27) 750 nm
28) 9.4×10^{-3} m
29) 827 nm
30) 39.9°
31) 529 nm
32) 403 nm
33) 99.6 nm
34) 1.30
35) 100 nm
36) 100