Test IV

Name ______________________________

1) In a single slit diffraction experiment, the width of the slit is $3.1 \times 10^{-5}$ m and the distance from the slit to the screen is 2.2 m. If the beam of light of wavelength 600 nm passes through the slit and forms a diffraction pattern on the screen, what is the linear distance on the screen from the center of the diffraction pattern to the second dark fringe?
   A) 3.9 cm
   B) 4.2 cm
   C) 2.1 cm
   D) 8.5 cm
   Answer: D

2) In a single-slit diffraction experiment, a beam of monochromatic light passes through a slit of width 11.0 mm. If the first order dark fringe of the resulting diffraction pattern is at an angle of 4.31°, what is the wavelength of light?
   A) 827 nm
   B) 301 nm
   C) 602 nm
   D) 402 nm
   Answer: A

3) In a single slit diffraction experiment, the width of the slit through which light passes is increased. What happens to the central bright fringe?
   A) It becomes wider.
   B) It becomes narrower.
   C) It stays the same.
   D) None of the other answers is correct.
   Answer: B

4) 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 is doubled?
   A) It will be cut to one-quarter its original size.
   B) It will be cut in half.
   C) It will double.
   D) It will become four times as large.
   Answer: C

5) 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 distance from the slit to the screen is doubled?
   A) It will be cut to one-quarter its original size.
   B) It will be cut in half.
   C) It will double.
   D) It will become four times as large.
   Answer: C
6) How wide must a narrow slit be if the first diffraction minimum occurs at ±12° with laser light of 633 nm?

   a. $3 \times 10^{-6}$ m
   b. $3 \times 10^{-5}$ m
   c. $6 \times 10^{-6}$ m
   d. $6 \times 10^{-5}$ m
   e. $1.5 \times 10^{-6}$ m

Answer: a

7) The hydrogen spectrum has a red line at 656 nm, and a blue line at 434 nm. What is the first order angular separation between the two spectral lines obtained with a diffraction grating with 5000 rulings/cm?

   a. 7.7°
   b. 16.6°
   c. 6.6°
   d. 3.2°
   e. 19.2°

Answer: c

8) When you look at a single slit diffraction pattern produced on a screen by light of a single wavelength, you see a bright central maximum and a number of maxima on either side, their intensity decreasing with distance from the central maximum. If the width of the slit is decreased,

   a. the pattern shrinks in size. (central maximum less wide; other maxima in closer to it)
   b. the pattern increases in size. (central maximum wider; other maxima farther from it)
   c. it does not affect the size of the pattern.
   d. the width of the central maximum increases, but the other maxima do not change in position or width.
   e. the width of the central maximum decreases, but the other maxima do not change in position or width.

Answer: B

9) A general condition that two waves undergo destructive interference is

   a) their phase difference is zero.
   b) their phase difference is $\pi/2$ rad.
   c) their phase difference is $\pm \pi/2$ rad.
   d) their phase difference is an even integral multiple of $\pi$ rad.
   e) their phase difference is an odd integral multiple of $\pi$ rad.

Ans: e
10) Two coherent waves, each with amplitude $A$, reach the same point in phase. The amplitude of the superposed wave is _________.
   a) 0
   b) $A$
   c) 2 $A$
   d) 3 $A$
   e) 4 $A$
   Ans: c

11) Two coherent waves, each with intensity $I_0$, reach the same point in phase. The amplitude of the superposed wave is _________.
   a) 0
   b) $I_0$
   c) 2 $I_0$
   d) 3 $I_0$
   e) 4 $I_0$
   Ans: e

12) Two coherent waves reach the same point in phase. One wave has amplitude 8 units and the other has amplitude 6 units. The amplitude of the superposed wave is ______ units.
   a) 6
   b) 8
   c) 10
   d) 14
   e) 2
   Ans: d

13) If two coherent waves, one with intensity 8.0 units and the other with intensity 4.0 units, undergo destructive interference, what is the resulting intensity?
   a) 4.0 units
   b) 6.0 units
   c) −4.0 units
   d) 1.9 units
   e) 0.7 units
   Ans: e

14) Wave 1 has amplitude of 9.0 units and wave 2 has amplitude 4.0 units. What is the ratio of their intensities, $I_1/I_2$?
   a) 20
   b) 5.1
   c) 2.3
   d) 1.5
   e) 1.3
15) A thin film of soapy water, \( n = 1.37 \), is held vertical. Light of wavelength 600 nm is reflected from the film and horizontal dark lines appear. What is the thinnest soap film for which a bright band will occur?
   a) 150 nm
   b) 109 nm
   c) 90 nm
   d) 438 nm
   e) 219 nm
   Ans: b

16) What is the minimum thickness of a coating of magnesium fluoride (\( n = 1.38 \)) applied to glass (\( n = 1.50 \)) that gives a minimum reflection for 600 nm light?
   a) 600 nm
   b) 300 nm
   c) 435 nm
   d) 109 nm
   e) 100 nm
   Ans: d

17) What minimum thickness of oil (\( n = 1.50 \)) on the surface of water (\( n = 1.33 \)) would give constructive interference for 550 nm light with normal incidence?
   a) 78 nm
   b) 80 nm
   c) 92 nm
   d) 183 nm
   e) 275 nm
   Ans: c

18) In a Young’s double slit experiment, a 5\(^{th}\) order maximum occurs at an angle of 1.422\(^{\circ}\). If the screen is 3.90 m from the slits and the slit separation is 0.135 mm, what wavelength is being used?
   a) 3350 nm
   b) 670 nm
   c) 335 nm
   d) 589 nm
   e) 690 nm
   Ans: b

19) A double-slit experiment is performed and then redone using slits of double the previous separation. Nothing else is changed. If the approximation \( \sin \theta \approx \theta \) holds, what happens to the angle between the maxima?
   a) It stays the same.
   b) It doubles.
   c) It quadruples.
d) It halves.
e) It quarters.
Ans: d

20) If the two 2\textsuperscript{nd} order maxima (m = 2) are separated by 2.0 cm on the screen in a double-slit experiment, what is the separation of the m = 3 minima? Assume the angle is very small.
a) 1.5 cm  
b) 2.0 cm  
c) 2.5 cm  
d) 3.0 cm  
e) 3.5 cm  
Ans: e

21) A grating is made with 600 slits per millimeter. What is the slit separation?
a) 600 nm  
b) 1.67 \times 10^{-6} \text{ m}  
c) 3.33 \times 10^{-6} \text{ m}  
d) 1600 \text{ pm}  
e) 916 \text{ nm}  
Ans: b

22) A laser beam is shown through a grating and a first-order maximum is produced at an angle of 25°. At what angle is the second-order maximum produced?
a) 75°  
b) 58°  
c) 50°  
d) 35°  
e) 27°  
Ans: b

23) Light of wavelength 450 nm produces a first-order maximum at 27° when viewed through a grating. At what angle would a first order maximum occur for a wavelength of 600 nm viewed through this grating?
a) 54°  
b) 40°  
c) 36°  
d) 37°  
e) 14°  
Ans: d

24) A single slit of width 0.030 mm is used to project a diffraction pattern of 500-nm light on a screen at a distance of 2.00 m from the slit. What is the width of the central maximum?
a) 1.7 cm  
b) 3.3 cm
c) 6.7 cm
d) 1.5 mm
e) 3.0 mm
Ans: c

25) In a double-slit experiment, when both interference and diffraction are taken into account, which is the lowest order maximum that is missing in the case where the slit separations is 0.020 mm and the slit widths are each 0.005 mm?
a) 1
b) 2
c) 3
d) 4
e) No order is missing.
Ans: d

26) In a single-slit experiment, light of wavelength 500 nm is used to produce a diffraction pattern on a screen 4.0 m away. If the distance between both 3rd order minima is 6.0 cm, what is the slit width?
a) 2.0 x 10\(^{-4}\) m
b) 1.0 x 10\(^{-4}\) m
c) 4.0 x 10\(^{-4}\) m
d) 0.67 x 10\(^{-4}\) m
e) 0.44 x 10\(^{-4}\) m
Ans: a

27) Two point sources of light of wavelength 600 nm are being viewed by a telescope of aperture width 2.0 cm. What is the closest angular separation at which the two sources can be resolved?
a) 7.3 x 10\(^{-5}\) rad
b) 3.7 x 10\(^{-5}\) rad
c) 7.3 x 10\(^{-5}\) deg
d) 3.7 x 10\(^{-5}\) deg
e) 4.2 x 10\(^{-3}\) deg
Ans: b

28) X-rays of wavelength 0.080 nm are used in a Bragg scattering experiment with a crystal. If the first order maximum is found at a grazing angle of 6.0\(^{\circ}\), what is the plane spacing in the crystal?
a) 0.31 nm
b) 0.71 nm
c) 1.4 nm
d) 0.38 nm
e) 0.77 nm
Ans: d