Name: _____ Class: _____ Date: _____ ID: A

quiz4

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 1. A Young's double-slit apparatus is set up. A screen is positioned 1.60 m from the double slits and the spacing between the two slits is 0.040 0 mm. The distance between alternating bright fringes is 1.42 cm. What is the light source wavelength? (1 nm = 10^{-9} m)
a. 710 nm
b. 490 nm
c. 280 nm
d. 355 nm
e. 675 nm

$\sin\theta \approx y/L$

$\lambda = d\sin\theta = dy/L = \frac{1.42\times10^{-2}\times4\times10^{-5}}{1.6}\,m = 3.55\times10^{-7}\,m$

____ 2. What is the minimum thickness of a glycerin film (n = 1.47) on which light of wavelength 600 nm shines that results in constructive interference of the reflected light? Assume the film is surrounded front and back by air.
a. 75 nm
b. 102 nm
c. 150 nm
d. 204 nm
e. 300 nm

$2t = \lambda_n/2 = \lambda_0/2n$

$t = \frac{600\,nm}{4\cdot1.47} = 102\,nm$

____ 3. Two flat glass plates are in contact along one end and are separated by a sheet of tissue paper at the other end. A monochromatic source of wavelength 490 nm illuminates the top plate. If 21 dark bands are counted across the top plate, what is the paper thickness? (1 nm = 10^{-9} m)
a. 2.7×10^{-6} m
b. 3.4×10^{-6} m
c. 4.9×10^{-6} m
d. 5.8×10^{-6} m
e. 6.3×10^{-6} m

[See pg 795] at each dark band $t_{air} = m\lambda/2$
The first dark band corresponds to $m=0$, the 21st corresponds to $m=20$. $\Rightarrow t_{paper} = 20\lambda/2 = 4.9\times10^{-6}\,m$

____ 4. Light of wavelength 610 nm is incident on a slit of width 0.20 mm and a diffraction pattern is produced on a screen that is 1.5 m from the slit. What is the distance of the second dark fringe from the center of the bright fringe? (1 nm = 10^{-9} m)
a. 0.68 cm
b. 0.92 cm
c. 1.2 cm
d. 1.4 cm
e. 1.7 cm

$2\frac{\lambda}{a} = \sin\theta_2$

$y_2 \approx L\sin\theta_2 = \frac{2\lambda L}{a} = \frac{2\cdot610\times10^{-9}\cdot1.5}{2\times10^{-4}}\,m = 0.915\,cm$

____ 5. At what angle will the second order maximum occur for a wavelength of 400 nm using a diffraction grating with 10 000 lines per cm?
a. 15.5°
b. 24°
c. 53°
d. 72°
e. No second order maximum will occur in this case.

$d = \frac{1\,cm}{10{,}000} = 1000\,nm$

$\sin\theta = 2\lambda/d = .8 \qquad \sin^{-1}(.8) = 53°$

____ 6. A compound microscope has an eyepiece that:
a. uses a real image from the objective as the object and forms its own real image.
(b) uses a real image from the objective as the object and forms a virtual image.
c. uses a virtual image from the objective as the object and forms its own real image.
d. uses a virtual image from the objective as the object and forms its own virtual image.

____ 7. The Palomar reflecting telescope has a parabolic mirror with an 80 m focal length. What is the magnification achieved when an eyepiece of focal length 2.5 cm is used?
a. 800
b. 1 200
c. 1 600
(d) 3 200
e. 8 400

$m = \frac{f_o}{f_e} = 3200$

____ 8. A binary star system in the constellation Orion has an angular separation between the stars of 10^{-5} radians. Assuming a wavelength of 500 nm, what is the smallest aperture (diameter) telescope that will just resolve the two stars? (1 nm = 10^{-9} m)
a. 3.0 cm
b. 4.2 cm
(c) 6.1 cm
d. 12.6 cm
e. 18.0 cm

$\theta = 1.22 \lambda / D$

$D = \frac{1.22 \cdot 500\,nm}{10^{-5}} = 6.1\,cm$