Practice Quiz 8

These are Q's from old quizzes. I do not guarantee that the Q's on this year's quiz will be the same, or even similar.

A laser beam shines vertically upwards. What laser power is needed for this beam to support a flat piece of aluminum foil with mass 15 microgram and diameter equal to that of the beam? (a) assume the aluminum fully reflects the beam. (b) assume the aluminum is pitch black, and fully absorbs all the beam.

A) 40W; 80W
B) 20W; 40W
C) 10W; 20W
D) 10W in either case
E) 40W in either case

B

An electric field in an EM wave traveling northeast oscillates up and down. In what direction does the magnetic field oscillate?

A) north–south
B) up–down
C) northeast–southwest
D) northwest–southeast
E) east–west

D

What's the minimum thickness of a soap film (n=1.33) in which 550nm light will undergo constructive interference?

A) 400nm B) 300nm C) 200nm D) 100nm

D

A lense with a circular aperture of 1cm in diameter is just barely capable of seperating two objects that are 1 degree apart. What's the wavelength of the light from the two objects?

A

a) 0.1mm b) 1mm c) 10mm d) 100mm e)1m

Poarizeddlight passes through a sequence of two polarizer whose axes of polarization form a 60 degrees angle. The second polarizer has the same polarization as the incoming light before it hits the first polarizer. What fraction of the incident intensity emerges from the set of polarizers?

A) 1/2 B) 1/4 C) 1/8 D) 1/16 E) 0

D

A grating with 6000 gratings across 1cm is used to seperate the two wavelengths of 550nm and 480nm. What's the maximum achievable angular seperation?

A) 6 degrees
B) 180 degrees
C) 10 degrees
D) 20 degrees
E) 30 degrees

D

What's the closest wavelength to 480nm that can still be resolved as a seperate wavelength using a grating with 6000 gratings across 1cm.

A) 480.1nm
B) 480.04nm
C) 480.03nm
D) 480.02nm
E) 480.000001nm

C

You are shining light with a wavelength of 480nm on a 5–slit aparatus with slit spacing of 1 micron. At what angle from the center do you find the 3rd dark fringe?

A) 5 degrees
B) 10 degrees
C) 15 degrees
D) 20 degrees
E) more than 25 degrees

C

In what way is a set of two small but widely seperated radio telescope superior than one large telescope? In what way is the large telescope superior?

A) The two small ones provide better angular resolution while the one large one can pick up weaker light signals.
B) The two small ones provide better angular resolution while the one large one has better frequency resolution.
C) The two small ones provide no advantage.
D) The one large one provides no advantage.
E) The two options are equal as long as the distance between the two small once is the same as the overall size of the large one.

A

The International Ultraviolet Explorer satellite carries a spectrometer with a 2cm wide grating ruled at 102 lines per mm. What is the minimum wavelength difference it can resolve in twelfth order when observing in the ultraviolet at around 155nm?

A) 0.0005 nm B) 0.005nm C) 0.05nm D) 0.1nm E) 1nm

B

In a 7–slit system, how many minima lie between the zeroth–oder and first–order maxima?

A) 1 B) 4 C) 5 D) 6 E) 7

D

How much do you need to move one of the two mirrors of a Michelson interferometer in order to switch maximas into minimas and back into maximas in the interference pattern the observer sees?

A) half a wave length
B) one eighth of a wave length
C) 3/4 of a wave length
D) quarter of a wave length
E) one wave length

A

What limits the angular resolution of earth based radio astronomy?

A) The maximum size radio telescope that can technically be built.
B) The radius of the earth.
C) The manufacturing precision of lenses in the radio frequency range, i.e. spherical aberation.
D) Dispersion, i.e. chromatic aberation.

B

(Note: Think about the fundamental limits)

Imagine holding a circular disk in a beam of monochromatic light. If diffraction occurs at the edge of the disk, the center of the shadow is:

A) a bright spot
B) darker than the rest of the shadow
C) bright or dark, depends on the wavelength
D) bright or dark, depends on the distance to the screen

A

A double slit system is used to measure the wavelength of light. The system has slit spacing d=15 micron and slit–to–screen distance L=2.2m. If the m=1 maximum in the interference pattern occurs 7.1cm from the screen center, what is the wavelength of the light?

A) 375nm B) 400nm C) 425nm D) 450nm E) 475nm

E

The movie "Patriot Games" has a scene in which CIA agents use spy satellites to identify individuals in a terrorist camp. Suppose that a minimum resolution for distinguishing human features is about 5cm. If the spy satellite's optical system is diffraction limited, what diameter mirror or lens is needed to achieve this resolution from an altitude of 100km? Assume a wavelength of 550nm.

A) 1000m B) 0.1m C) 100m D) 10m E) 1m

E

What's the closest wavelength to 480nm that can still be resolved as a seperate wavelength using a grating with 6000 gratings across 1cm.

A) 480.03nm
B) 480.1nm
C) 480.000001nm
D) 480.04nm
E) 480.02nm

A

DVD technology encdes the binary information as depressions in the information layer of the DVD. The zeros and ones are detected via interference of a laser beam with itself after it reflects from the information layer. The depth of the depressions is thus tuned to the wavelength of the laser used. For DVDs laser with wavelength of about 640nm are used. What do you think is the depth of the depressions?

a. 40nm
b. 80nm
c. 160nm
d. 320nm
e. 640nm

C

E

A double slit system is used to measure the wavelength of light. The system has slit spacing d=15 micron and slit-to-screen distance L=2.2m. If the m=1 maximum in the interference pattern occurs 7.1cm from the screen center, what is the wavelength of the light?

A) 375nm B) 400nm C) 425nm D) 450nm E) 475nm