Physics 112, spring 2015 Exam 3 42 points

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RULES

You may use an equation sheet with whatever you want on both sides, you may not use a tablet or a smartphone or a laptop as a calculator. Do not forget to include direction in all answers. Please return the test to me. Write all your answers on a separate piece of paper. Paper and staplers will be provided. You may bring one sheet of equations and one sheet with sign conventions

Problems

1:)(6 pts) You are standing one meter from your bathroom mirror.

How tall is your image compared to you?

Is it upright or inverted?

Is it real or virtual?

How much older are you than your image?

2:)(10 pts) An object is placed 10 meters to the left of a converging lens with a focal length of 4 meters.

Where is the image formed?

Is it real or virtual?

What is the magnification?

Draw a ray diagram to support your conclusions.

To what object distance would the object need to be placed for the image to form at the focal point on the backside of the lens? What type of objects are at this distance?

3:)(8 pts) A diver swimming underwater sees the sun as appearing 45 degrees from the vertical?

Where is the Sun's actual position (angle wise) with respect to the vertical?

Assuming 550 nm light, what is the speed of this light under water and what is it's wavelength under water? Water has n = 1.33.

What would happen to the apparent location of the sun if it shone only in blue light (400 nm) or only in red light (700 nm).

4:)(8 pts) A screen is separated from a double slit source by 1.2 meters. The distance between slits is $1\mu m$. The second order bright fringe (2 away from the zeroth order) is measured to be .05 meters from the centerline. I want y coordinates. (hint - the small angle approximation works here).

What is the wavelength of the light?

Where is the first location of destructive interference? Hint (m=2 for the first part) there is an m = 1 and an m = 0 also).

5:) (5 pts) A gamma ray photon has a wavelength of $10^{-15}m$. A radio photon has a wavelength of

1m. Calculate the frequency and energy of each photon. Plank's constant is $6.62 \times 10^{-34} Js$.

6:) CONCEPTUAL

A: When and how does a rainbow form? Draw a picture and include relevant concepts. Draw the path of a light ray going in and coming out. (4 pts)

B: What is the one distinction between light from one slit and light from another slit (slits are separated by a distance d) that leads to either constructive or destructive interference on a screen a distance L away? (2 pts)

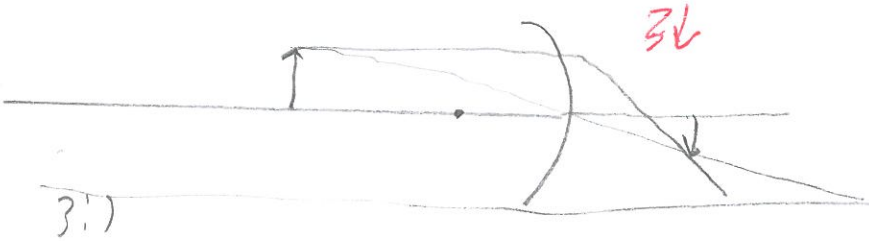
EXTRA CREDIT What is the thickness of a soap bubble that constructively reflects 550 nm light. Assume water's index of refraction and the zeroth order. What are the next two wavelengths of light this same soap bubble constructively reflects?

1:) Same ↑ ↓ $\Delta t \cdot 10^{-8}$ s

1 1 1 2 5

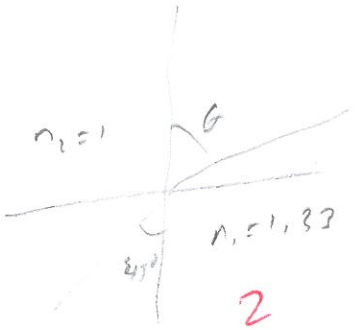
2:) $\frac{1}{F} = \frac{1}{p} + \frac{1}{q}$ 6.6 right R $m = -\frac{q}{p}$ $-\delta$ ∠ Stars

1 2 1 1 1 2 1



3L 10

3:)



2

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

70° $\frac{3 \cdot 10^8}{1,33} \Rightarrow \Delta = \frac{c}{v}$ $v = \frac{c}{n} = 2,25 \cdot 10^8 \frac{m}{s}$

1 1 1

$\frac{n_1 \lambda_1}{n_2} = \lambda_2 = 413,5\ nm$, Shift up and down

1 1 1 8

4: $\frac{y}{L} = \tan\theta$ $d \sin\theta = m\lambda$ $\frac{dy}{L} \approx m\lambda$ $y_2 \approx \frac{2L\lambda}{d}$

2

$\frac{dy}{mL} = \lambda = 2,08 \cdot 10^{-8} m$, $\frac{y}{4}$ $5,2 \cdot 10^{-9}$ m

2 1 2

8

5.) $E = hf = \frac{hc}{\lambda}$ 2 1

$E_{1m} = 1,99 \cdot 10^{-25}\ J$ $E_{10^{-10}m} = 1,99 \cdot 10^{-15}\ J$ 1

$1,2 \cdot 10^{-16}\ eV$ 2 $1,2 \cdot 10^{9}\ eV$ 1 5

6.) Picture → ~~1~~ 2

dispersion → 1

reflection/refraction ~~1~~ 2 4

Path length $S = |r_1 - r_2|$ 2 6

EC $2nT = (m + \frac{1}{2})\lambda$

$\frac{\lambda}{2} \cdot \frac{1}{2n} = T$ $183,3\ nm$ $550 = m \cdot 0$

$110,00$ $103,4\ nm = Thickness$

$\frac{2nT}{m + \frac{1}{2}}$