PHY 102 Quiz #6 Name _____

Score _____

Instructions:
1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your **answers in a box.**
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

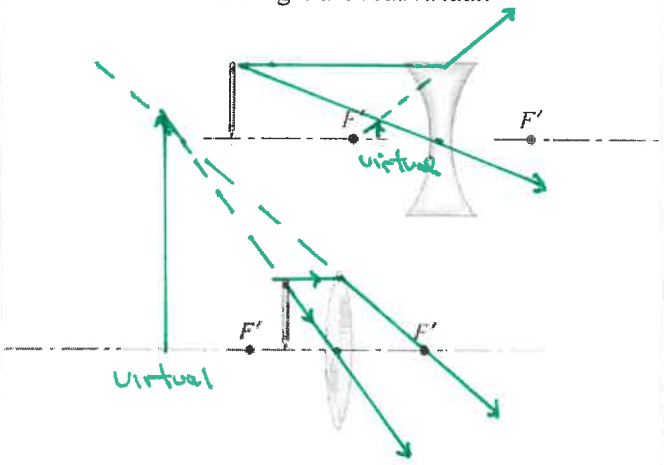
1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. Which of the following is bent the most as it passes through a diffraction grating?
a) red. b) green. c) blue. d) yellow. a

b. The separation of light into its component colors is called
a) refraction; b) dispersion; c) polarization; d) reflection. b

c. Nearsighted vision can be corrected by using
a) a converging lens; b) a diverging lens;
c) more intense light; d) none of these b

2. **Definition/Principle (7 pts)**
a. Sketch the ray diagrams clearly showing the images and indicate if the final images *are real/virtual.*



b. Label the location of the red bands on the primary and secondary rainbow.

3. **Problems (10 pts)**
a. A farsighted person has a near point of 75.0 cm. What focal length lens is needed to correct this?

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{25} + \frac{1}{-75} = \frac{2}{75}$

$f = 37.5\text{cm}$

b. The photograph of a monkey four feet high is to be taken by a camera lens which has a 9 inch focal length. The monkey stands 9 feet in front of the camera lens. How large is the image, {Use inches; do not convert to metric!]

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{d_i} = \frac{1}{9/4} - \frac{1}{9} = \frac{12}{9} - \frac{1}{9} = \frac{11}{9}$

$d_i = \frac{9}{11} = .82\text{ft} = 9.9''$

$m = -\frac{d_i}{d_o} = -\frac{9/11}{9} = -\frac{1}{11}$

$h_i = m h_o = -.364'$

$= 4.36''$

c. With two slits spaced 0.20 mm apart and a screen at a distance of L = 1.00 m, the third bright fringe is found to be displaced 7.50 mm from the central fringe. Find the wavelength of the light.

$d\sin\theta = m\lambda$

$\lambda = \frac{d}{m}\sin\theta$

$\approx \frac{d}{m}\tan\theta = \frac{dy}{mL}$

$= \frac{(2\times10^{-4})(7.5\times10^{-3})}{3(1)} = 500\text{nm}$

d. Two sources of light are in phase and emit waves that have a wavelength of 0.44 m. Determine whether constructive or destructive interference occurs at a point whose distances from the sources are

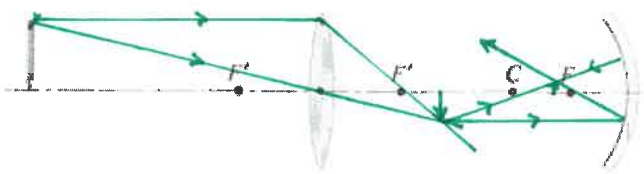
i. 1.32 m and 3.08 m;

$|3.08 - 1.32| = 1.76 = 4\lambda$ Constructive

ii. 2.67 m and 3.33 m.

$|2.67 - 3.33| = .66 = \frac{3}{2}\lambda$ destructive

Bonus: Locate the final image. Is it real or virtual? real



PHY 102 Quiz #7 Name _____

Score _____

Instructions:
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4. Place your **answers in a box**.
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. Which is not a consequence of Einstein's postulates?
   a) Moving clocks tick slower than stationary ones.
   b) Simultaneous events in one inertial system may not be simultaneous in another system.
   c) Stationary lengths are smaller than moving lengths.
   d) None of these. c

b. A spaceship moves towards you at 1/3c, where c is the speed of light. The spaceship emits a beam of light in your direction. As measured in your frame of reference, the speed of the light emitted by the spaceship is:
   a) 4/3*c*. b) *c*. c) 2/3*c*. d) 1/3*c*. b

c. You have two polarizing filters lined up so they block all the light. You can increase the light that gets through by
   a) placing a third filter in front of the first.
   b) placing a third filter after the second.
   c) placing a third filter in between the two.
   d) a third filter won't transmit more light. c

2. **Definition/Principle (5 pts)**

a. What is an inertial reference frame?

coord sys at const velocity

b. What is Huygen's Principle?

points on wavefronts act as sources

c. What is the energy equivalent of a 0.75 g mass?

$E = mc^2 = .75\times10^{-3}(3\times10^8)^2$

$= 6.75\times10^{13}$ J

Bonus: In *Planet of the Apes* (original movie), the crew left Earth in July 1972. After six months, it was May 2673 back on Earth. How fast were they moving? 700.9 yrs

$700.9 = \frac{.5}{\sqrt{1-v^2/c^2}}$

$\frac{v}{c} = .999$

3. **Problems (12 pts)**

a. A thin film of an anti-reflective coating ($n = 1.30$) coats a thin lens ($n = 1.69$). What is the minimum thickness of the film if 530 nm wavelength light is not reflected??

1.00
1.30
1.69

$2t + \frac{\lambda_f}{2} + \frac{\lambda_f}{2} = (m+\frac{1}{2})\lambda_f$

$2t = (m-\frac{1}{2})\lambda_f$

$t = \frac{\lambda}{4n} = 102\text{nm}$

b. Unpolarized light with intensity 3.6 W/m^2 strikes a piece of polarizing material with transmission axis at 30° to the horizontal. The emerging light comes into contact with polarizing material with a vertical polarization. What is light intensity that is transmitted through these materials?

$S = \frac{1}{2}(3.6)\cos^2 60 = 0.45\,\text{W/m}^2$

c. A UFO streaks across the sky at a speed of 0.60*c* relative to the Earth. A person on the Earth determines that the UFO is 240 m long in the direction of its motion.

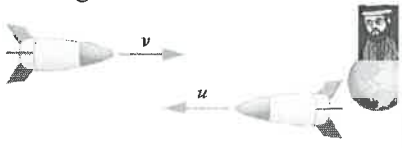
i. What length do they measure for the UFO when it lands?

$L_0 = \gamma L = \frac{5}{4}(240) = 300\text{m}$

ii. The UFO took a 30 year trip (Earth time) to pick up an alien. How much time passed on the UFO clock?

$\Delta t_0 = \frac{\Delta t}{\gamma} = \frac{30}{5/4} = 24\text{yr}$

d. An observer sees two ships traveling towards each other at 0.75*c*. How fast does the captain of the ship on the left think the other ship is moving?



$u' = \frac{u-v}{1-\frac{uv}{c^2}}$

$= \frac{-0.75c-0.75c}{1+.75^2} = .96c$

$(= 2.88\times10^8\,\text{m/s})$