PHY 102 Quiz #7 **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.

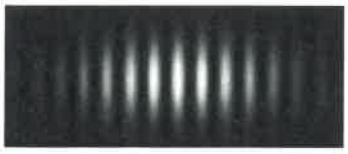
1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. If a car could travel at half the speed of light, then the light emerging from its headlights would travel
a) less than c; b) more than c; c) equal to c. c

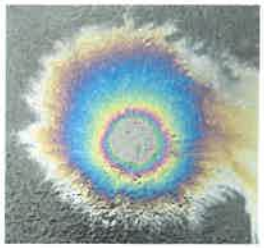
b. On a highway there is a flashing light to mark the start of a section of the road where work is being done. Who measures the proper time between two flashes of light?
a) a worker standing still on the road.
b) a driver in a car approaching at a constant velocity.
c) both the worker and the driver.
d) neither the worker nor the driver. a

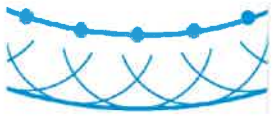
c. The images of two sources are said to be resolved when what is true of the diffraction patterns?
a) The central maxima fall on each other.
b) The first bright fringes fall on each other.
c) The central maximum of one pattern falls on the first dark fringe of the other one. d) None of these. c

2. **Definition/Principle (5 pts)** For each picture identify the specific physics (term/principle) it is designed to show.



a. diffraction b. Rayleigh criterion





c. Thin film Interference d. Huygen's Principle

e. Polarization

3. **Problems (12 pts)** *A long time ago in a galaxy far, far away … there was a small planet named Tatooine.*

a. Luke Skywalker can travel from his home on the planet Tatooine to the capital in 35.0 minutes as measured from his X-wing star fighter traveling at a speed of *0.80 c.* What time would be measured on Tatooine?

$\Delta t = \gamma \Delta t_0 = \frac{5}{3}(35) = 58\text{min}$

b. The length of the Millennium Falcon at rest is 34.37 m. What would an observer on Tatooine measure as it flew at *0.60c*?

$L = \frac{L_0}{\gamma} = \frac{34.37}{1.25} = 27.5\text{ m}$

c. A soap bubble has no green (540 nm) when viewed head on. What is the minimum thickness for the soap film if its index of refraction is 1.40?

$2t + \frac{\lambda_f}{2} = \lambda_f + \frac{\lambda_f}{2}$

$t = \frac{\lambda}{2n} = \frac{540}{2(1.40)} = 193\text{nm}$

d. Unpolarized light with intensity 12.0 W/m^2 strikes a piece of polarizing material. It passes through and comes into contact with another polarizing material, which is at 60° with respect to the first. What is light intensity that is transmitted through these polarizing materials?

$S = \frac{1}{2}(12)\cos^2 60 = 1.5\text{W/m}^2$

e. Light of wavelength 672 nm in a vacuum is incident on a single slit of width 1.60×10^{-5} m. Find the location of the third dark fringe two meters away.

$W\sin\theta = 3\lambda, \quad \tan\theta = \frac{y}{L}$

$y = L\left(\frac{3\lambda}{W}\right) = 2\left(\frac{6.72\times10^{-7}\cdot 3}{1.6\times10^{-5}}\right) = 25\text{cm}$

Bonus. The total energy of an object is 7.86×10^{12} J and its kinetic energy is 6.17×10^{12}. What is the mass of the object?

$E - KE = mc^2$

$m = \frac{(7.86-6.17)\times10^{12}}{(3\times10^8)^2} = 1.88\times10^{-5}\text{ kg}$

$m = 8.7\times10^{-5} - 6.8\times10^{-5}$ or .0188g