

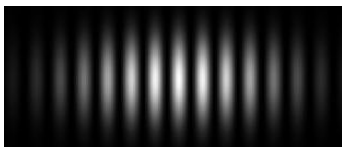
Instructions:

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.

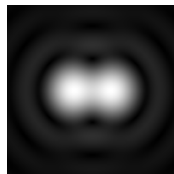
1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

- 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 . _____
- 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. _____
- 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. _____

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



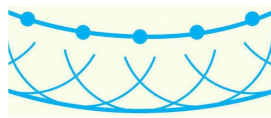
a. _____



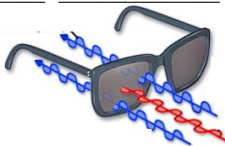
b. _____



c. _____



d. _____



e. _____



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 $0.80c$. What time would be measured on Tatooine?
 - b. The length of the Millennium Falcon at rest is 34.37 m. What would an observer on Tatooine measure as it flew at $0.60c$?
- 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?
- 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?
- e. Light of wavelength 672 nm in a vacuum is incident on a single slit of width $1.60 \times 10^{-5} \text{ m}$. Find the location of the third dark fringe two meters away.

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