

Physics 256 Assignment 3 Fall 2012
Submit online or Place in Phys 256 box, Phys 2nd floor Wednesday October 3rd,
2012 by 4pm 42 marks total

1 Follow up question from Hecht Problem 3.14. What is the photon flux from the light bulb assuming negligible heat loss and a wavelength of 600 nm? 5 marks

2 a) For the blue wavelength in slide 11, show whether the wavelengths and energies given are consistent. 5 marks

b) For the red light, no electron is freed from the surface. Why is this? 2 marks

c) What is the momentum of a green photon in slide 11? 5 marks

d) Do Hecht Problem 3.58 5 marks

3 a) A 200 mW laser is focused in an optical trap to create “laser tweezers”. What is the force of the laser on a particle which reflects all of the light? 3 marks

b) What is the photon flux if the wavelength is 500 nm? 3 marks

c) If the laser beam is focused so that its cross section is $9 \mu\text{m}^2$ what is the average radiation pressure of the beam incident perpendicular to a cell which absorbs all the light? 5 marks

d) What is the photon flux density of the beam? 3 marks

4) A satellite has a “photon sail” of size 50 m by 50 m. What is the force exerted on it by sunlight if it strikes the mirror at an angle of 45° from the normal? The irradiance of sunlight is 1400 W/m^2 measured with a detector whose surface is perpendicular to the sun’s rays. 7 marks Hint: *You might find it helpful to calculate the power and irradiance incident on the mirror first. Remember that force is a vector.*