

## World of Light - Exam 2 study guide

Exam 2 will be on Friday, May 22.

**Bring a calculator to the exam** (*smart phones are fine*).

The exam will cover:

- material that we've learned in class
- labs 3 and 4
- problem sets 4, 5, and 6
- book chapters 3, 4, 5, 6, and 7

This exam will be mostly on the material that we covered since the last exam. However, many concepts carry over from before, such as the wave and particle natures of light. Following is a list of topics that we have covered since the last exam. For each one, you should know what the terms mean, be able to provide examples of them, be able to draw diagrams as appropriate, and be able to do simple calculations as appropriate. Focus particularly on the topics that were also on the problem sets or in the labs.

### Properties of light

photon energy and momentum

radiation pressure, laser tweezers, laser Doppler cooling

correspondence between wavelength and frequency

### Reflections and mirrors

qualities of a mirror - flatness, size

specular and diffuse reflection

law of reflection, normal to a surface

behaviors of the types of mirrors - flat, parabolic, retroreflector, concave, convex

virtual and real images

center and focus for a curved mirror

reading and drawing ray diagrams

converging and diverging mirrors

relationship between object and image positions

which way images are inverted, chirality

### Refraction and lenses

Snell's law of refraction

relationship between object and image positions

correspondence between mirrors and lenses

index of refraction

change of wavelength, velocity, and frequency upon change of medium

dispersion, prisms

total internal reflection, critical angle, evanescent wave

Fermat's principle of least time

mirages

cameras, human vision, microscopes, telescopes

### Diffraction and interference

diffraction through a hole, effects of hole size

constructive and destructive interference

interference causing colors in soap bubbles, bird feathers, butterfly wings, etc.

thin film interference

two slit interference

Poisson/Arago point

diffraction and Heisenberg uncertainty principle

### Polarization

polarized and unpolarized light

waves that are and aren't polarizable

mechanisms that produce polarization - selective absorption, low angle reflection,

Rayleigh scattering, birefringence

crossed polarizers

optical activity of chiral molecules

LCD function

### Line spectra

line and continuous spectra

atomic and molecular energy levels

Hydrogen energy levels, Rydberg formula, ionization energy

electronic, vibrational, rotational energy levels

thermal energy, population of energy levels with systems

energy level transitions - radiative, non-radiative, connection with resonance and coupling

fluorescence - examples and energy level diagram

phosphorescence

lasers - energy level diagram, population inversion

### Blackbody radiation

what a blackbody is

blackbody spectrum

Wien's displacement law, relationship between temperature and emission color

Stefan-Boltzmann law, relationship between temperature and amount of radiation

absorption and emission differences between black and white/silver objects

steady state radiation between object and surroundings

### Greenhouse effect

what greenhouse effect and global warming are

causes of greenhouse effect and global warming