2012 Phoenix **Invitational**

February 4, 2012

Optics

Instructions:

1. **READ ALL THESE INSTRUCTIONS CAREFULLY BEFORE STARTING!**
2. Do not open this test until instructed to.
3. Be sure to write legibly.
4. Fill out your Team name and number.
5. Where relevant, answers must include APPROPRIATE SI UNITS and significant figures.
6. The testing period is over at 45 minutes past the start time and plus 4 minutes laser shoot. We will give time warnings at 5 and 1 minutes. Stop writing when told to. Be sure to turn in ALL pages.
7. Each question is worth 2 point. An answer either is fully correct and gets all points or is wrong and gets no points.
8. Proceed to the laser shoot when your team No. is called (4 Minutes)

Team Name: _____

Team No.: _____

Student Names: _____

Part 1 – Geometric Optics (30 Points)

Multiple Choices

Identify the choice that best completes the statement or answers the question

____ 1. Snow reflects almost all of the light incident upon it. However, a single beam of light is not reflected in the form of parallel rays. This is an example of _____ reflection off of a _____ surface

a. regular; rough **b.** regular; specular **c.** diffuse; specular **d.** diffuse; rough

____ 2. If a light ray strikes a flat mirror at an angle of 14 degree from the normal, the reflected ray will be

a. 13 degree from the mirror's surface **b.** 27 degree from the normal
c. 76 degree from the mirror's surface **d.** 70 degree from the normal

____ 3. If you stand 3.0 m in front of a flat mirror, how far away from you is your image?

a. 1.5 m **b.** 3.0 m **c.** 6.0 m **d.** 12.0 m

____ 4. A diverging (concave) lens can form images that are?

a. virtual, upright **b.** real, upright **c.** virtual, inverted **d.** real, inverted

____ 5. Which of the following best describes the image produced by a flat mirror?

a. Virtual, inverted, and magnification greater than one
b. Real, inverted , and magnification equal to one
c. Virtual, upright, and magnification equal to one
d. Real, upright, and magnification equal to one

____ 6. A man is walking at 1.0 m/s directly towards a flat mirror. At what speed is his separation from his image decreasing?

a. 1.0 m/s **b.** 2.0 m/s **c.** 3.0 m/s **d.** 0 m/s

____ 7. Refraction is the term for the bending of a wave disturbance as it passes at angle from one ____ into another.

a. glass **b.** medium **c.** area **d.** boundary

____ 8. The point at which a lens, reflector or antenna directs incoming parallel light rays

a. lens **b.** Medium **c.** Normal. **d.** focus

____ 9. Which is an example of refraction?

a. A parabolic mirror in a headlight focuses light into a beam.
b. A fish appears closer to the surface of the water than it really is when observed from river
c. In a mirror, when you lift your right arm, the left arm of your image is raised
d. Light is bent slightly around corners

____ 10. The ratio of the speed of light in a vacuum to the speed of the light in a certain material.

a. law of refraction **b.** index of refraction **c.** law of reflection **d.** diffraction.

Short Answers

11. The critical angle for the internal reflection inside a certain transparent material is found to be 48 degree. If entering light has an angle of incidence of 52 degree, predict whether the light will be refracted or it will undergo total internal reflection.

Questions 12-15: A 7 cm object is placed along the principle axis of a thin converging lens that has a focal length of 22 cm. If the distance from the object to the lens is 36 cm,

12. What is the distance from the image to the lens ?

13. Image orientation

14. Image type

15. Image Size

Part 2 – Physical Optics (30 points)

Multiple Choices
Identify the choice that best completes the statement or answers the question

____ 1. The range of all possible electromagnetic frequencies. (This includes radio waves, microwaves, x rays and visible light)

a. Spectrum **b.** Electromagnetic spectrum **c.** Electromagnetic waves **d.** Spectrometer

____ 2. Electromagnetic radiation with wavelength longer than visible light but shorter than radio waves

a. Infrared light **b.** X- ray **c.** Ultraviolet light **d.** Gamma ray

____ 3. Change in the apparent frequency of a wave as observer and source move toward or away from each other.

a. Interference **b.** Blue shift **c.** Doppler effect **d.** Red shift

____ 4. The unit of frequency, equal to one cycle per second

a. Photon **b.** Hertz **c.** Joules **d.** Second

____ 5. Light with slightly higher frequency and shorter wavelength than visible light. Also called black light, causes tanning and sun burn.

a. Infrared light **b.** X-ray **c.** Ultraviolet light **d.** Polarized light

____ 6. What are the three primary colors used in addition

a. yellow, red, blue **b.** orange, green, purple **c.** brown, black, white **d.** red, green, blue

____ 7. The type of spectrum we see depends on the nature of the source.
Solids, liquids, and dense gases emit light of all wavelengths, without any gaps. We call this a____

a. Bright line spectrum **b.** Absorption spectrum
c. Visible light spectrum **d.** Continuous spectrum

____ 8. Thin gases emit light of only a few wavelengths. We call this a

a. Bright line spectrum **b.** Absorption spectrum
c. Visible light spectrum **d.** Continuous spectrum

____ 9. If there is a source of light behind it, a thin gas will absorb light of same wavelengths it emits. We call this a

a. Bright line spectrum **b.** Absorption spectrum
c. Visible light spectrum **d.** Continuous spectrum

____ 10. When the three colors: Cyan, Magenta and yellow are mixed together, the resultant color is:

a. black **b.** red **c.** white **d.** gray

Short Answers

11. In a dark room, magenta light is shined on a green T-shirt. What color does T-shirt appear to be?

12. What type of cell is responsible for color vision?

13. What primary color is the human eye most sensitive to?

14. Is the wavelength of blue light longer or shorter than orange light?

15. If the visible blue light has a wavelength of 475 nm, what is its frequency? (use $C = 3 \times 10^8$ m/s)

Tie Breaker:

T1 One of our local radio stations transmits at 96.9 Mhz. What is the wavelength of this signal?